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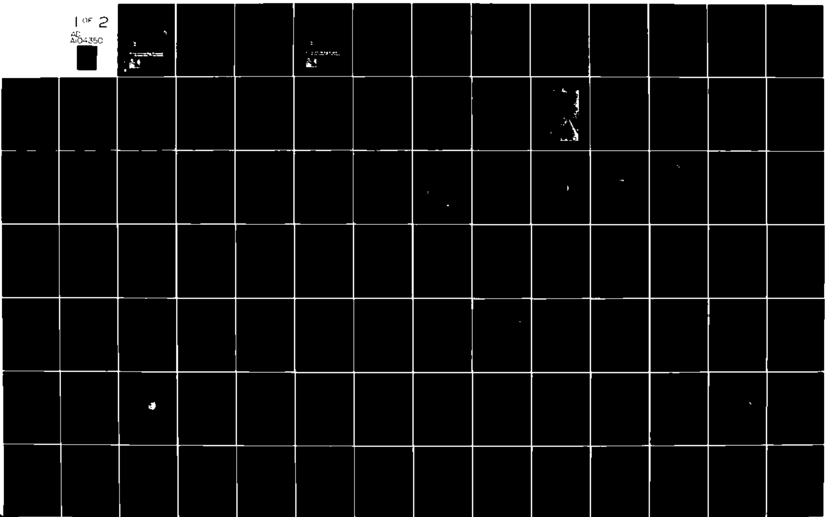

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Environmental Impact Analysis Process

DRAFT ENVIRONMENTAL IMPACT STATEMENT

CONSOLIDATED SPACE OPERATIONS CENTER

OCTOBER 1980

DEPARTMENT OF THE AIR FORCE

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The proposed Consolidated Space Operations Center (CSOC) is a ground control center that includes a complex of buildings and an antenna field. Operation of the CSOC will require a combined military and civilian labor force of about 2000 persons; when dependents are considered the CSOC population could total approximately 6,100 persons. The environmental impacts associated with construction and operation of the CSOC at three candidate locations (Peterson Air Force Base/Colorado Springs (con't)

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Item 20 continued

Colorado; Kirtland Air Force Base/Albuquerque, New Mexico; Malstrom Air Force Base/Great Falls, Montana) have been assessed and are the subject of this document.

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DRAFT ENVIRONMENTAL IMPACT STATEMENT

CONSOLIDATED SPACE OPERATIONS CENTER

OCTOBER 1980

DEPARTMENT OF THE AIR FORCE

PROPOSED CONSOLIDATED SPACE OPERATIONS CENTER (CSOC)

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Draft Environmental Impact Statement

ABSTRACT

The proposed Consolidated Space Operations Center (CSOC) is a ground control center that includes a complex of buildings and an antenna field. Operation of the CSOC will require a combined military and civilian labor force of about 2000 persons; when dependents are considered the CSOC population could total approximately 6,100 persons. The environmental impacts associated with construction and operation of the CSOC at three candidate locations (Peterson Air Force Base/Colorado Springs, Colorado; Kirtland Air Force Base/Albuquerque, New Mexico; Malmstrom Air Force Base/Great Falls, Montana) have been assessed and are the subject of this document.

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SUMMARY

The proposed Consolidated Space Operations Center (CSOC) is a ground control center that includes a complex of buildings and an antenna field. Initially five antennas would be installed with provisions for additional antennas as yet not identified. Operation of the CSOC would require a combined military and civilian labor force of about 2000 persons. When dependents are considered, the CSOC population could total approximately 6,100 persons.

The environmental impacts associated with construction and operation of the CSOC at three candidate locations (Peterson AFB/Colorado Springs; Kirtland AFB/Albuquerque; and Malmstrom AFB/Great Falls) are presented in this document. Since the number of personnel available from the local area are indeterminate at this time, a conservative assumption is used wherein all of the CSOC employees would be new to each of the locations considered. Under this assumption, the 'maximum' potential impacts are identified.

Environmental Impacts of the CSOC Project

The environmental impacts that are expected to occur with the construction and operation of the CSOC at each of the three candidate locations are not considered to be of significant magnitude. There are essentially four areas of concern that would be affected to varying degrees at each of the three candidate locations. They are:

- Air Quality: The CSOC project traffic would add to the degradation of air quality at all three locations. However, the percentage increase in yearly emissions is below 2% in Great Falls and under .5% in Colorado Springs and Albuquerque.
- Traffic: CSOC project traffic would add to the existing congestion at base entry gates and on local roads and base interior roads, particularly during rush hour. Because of the singular access road to the Colorado Springs CSOC site, project traffic would be concentrated on a single rural highway. This impact could be mitigated with car/van pooling and staggered work hours.

- Electromagnetic Radiation: Electromagnetic radiation from the CSOC antennas is not anticipated to be hazardous to occupational personnel at ground level. Electro-explosive devices carried on aircraft could be activated, however. For this reason aircraft should be restricted inside a 1000-foot radius of the antenna field. Under normal conditions there are no aircraft flying in the immediate vicinity of the CSOC site at either Colorado Springs or Albuquerque. At Malmstrom AFB considerable flight activity occurs in close proximity to the CSOC site due to the nearby runway.

- Public Schools: Public school enrollment has declined over the past few years at each of the three locations. The CSOC project could, depending on the number of new families moving into the area, require the re-opening of school facilities (classrooms) that have been closed during the past few years. In the Great Falls location, it may be necessary to re-open an entire school in the event the majority of the CSOC employees were new to the Great Falls area. Construction of new facilities would not be required as a result of CSOC.

In addition to the above impacts which are common to varying degrees at all three candidate locations, there are several considerations that are unique to one or two of the candidate sites. These are:

- Growth Inducement: The CSOC location 10 miles east of the urbanized area of Colorado Springs could encourage commercial development along Highway 94. Such development would be outside the areas of current growth patterns.

- Visual Intrusion: Both the Colorado Springs and Great Falls sites are such that portions of the CSOC would be visible from adjoining public roads, highways and scattered homes. This impact could be positive or negative depending on one's personal preferences, but would tend to be considered as an adverse impact by those who live in the immediate area.

Mitigation Measures

Mitigation measures that will be incorporated in the CSOC to alleviate adverse impacts are as follows:

- Staggered work hours to minimize local traffic congestion
- Car and van pooling will be encouraged to reduce air pollution, traffic congestion and gasoline consumption.

- Landscaping will be used to minimize visual obtrusion of the CSOC
- Field survey measurements will be conducted after antenna installation to identify specific areas, if any, where prohibited or restricted access is required due to electromagnetic radiation.
- Air traffic will be restricted within a 1000-foot radius of the antenna field to avoid accidental activation of electro-explosive devices.

Long-Term Benefits of the CSOC Project

The CSOC project would generate a positive influence on the local economy at each of the three candidate locations. In each area local businesses would be stimulated and unemployment would probably tend to decrease. The public school districts would benefit from the added federal funds generated by students of the CSOC employees.

From a national standpoint, the CSOC would enhance the national defense posture of the United States through its ability to protect national security data, respond to national defense priorities, and retain mission authority over military Space Shuttle missions.

Conclusion

CSOC would not cause a significant adverse environmental impact at any of the candidate locations. There appear to be some minor environmental impacts, which vary by type depending on the particular location concerned. These minor impacts appear evenly distributed among the alternative locations being considered.

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LIST OF ABBREVIATIONS

AAMI	Association for the Advancement of Medical Instrumentation
ADA	Average Daily Attendance
ADCOM	Air Defense Command
ADT	Average Daily Trips
AFB	Air Force Base
AFERN	Air Force Environmental Reference Number
AFOSH	Air Force Occupational Safety and Health
AFR	Air Force Regulation
ANSI	American National Standards Institute
AQMA	Air Quality Maintenance Area
BAQ	Bachelor Airmens Quarters
BOQ	Bachelor Officers Quarters
Btu or BTU	British Thermal Units
CF or cuft	Cubic feet
CO	Carbon Monoxide
CONUS	Continental United States
CSOC	Consolidated Space Operations Center
DLT	Data Link Terminal
DOD	Department of Defense
DOMSAT	Domestic (Commercial) Communications Satellite
DSCS	Defense Satellite Communications System Satellite
DU or du	Dwelling Units
E&A	Engineering and Administrative
EED	Electroexplosive Device
EIAP	Environmental Impact Analysis Process
EIS	Environmental Impact Statement
EMFAC	EPA Mobile Source Emission Factors
EMR	Electromagnetic Radiation
EPA	Environmental Protection Agency
ERP	Effective Radiated Power
ETAC	Environmental Technical Applications Center
FAA	Federal Aviation Administration
FCC	Federal Communications Commission
gpd	gallons per day
HAP	Housing Assistance Plan
hp or HP	Horsepower
ICU	Intersection Capacity Utilization
ITE	Institute of Transportation Engineers
kVA	Kilovolt-amperes
K	Kindergarten
kw or KW	Kilowatts
lb or lbs	Pounds
LECS	Local Economic Consequences Study
MCF	Million cubic feet
MCP	Military Construction Program
mgd	Million gallons per day
$\mu g/m^3$	Micrograms per cubic meter
MHz	Megahertz
MkW	Million Kilowatts
MPEL	Maximum Permissible Exposure Level
MSL	Mean Sea Level
MW	Megawatts

mw/cm^2	Milliwatts per square centimeter
NASA	National Aeronautics and Space Administration
NIOSH	National Institute of Occupational Safety and Health
NORAD	North American Air Defense Command
PPACG	Pikes Peak Area Council of Governments
ppm	Parts per million
rf or RF	Radiofrequency
RFR	Radiofrequency radiation
RMS	Root Mean Square
SAGE	Semi-Automatic Ground Environment System
SIP	State Implementation Plan
SCF	Satellite Control Facility
SCS	Satellite Control Satellite
SMSA	Standard Metropolitan Statistical Area
SOC	Satellite Operations Center
SOPC	Shuttle Operations and Planning Center
SO_2	Sulfur Dioxide
SPADOC	Space Defense Operations Center
STC	Satellite Test Center
TDRSS	Tracking and Data Relay Satellite System
TO	Technical Order
TSP	Total suspended particulates
UPS	Uninterruptible Power Supply
USAF	United States Air Force
v/c	Volume to capacity ratio
VOQ	Visitor Officers Quarters
VPH	Vehicles per hour, one direction only
WAPA	Western Area Power Administration
WX	Weather

PREFACE

This document has been prepared in accordance with the Council on Environmental Quality Regulations, 40 CFR, Part 1500, and Department of Defense Directive 6050.1.

A 'scoping process' was incorporated to identify the potential areas of environmental impact that needed to be addressed in the Environmental Impact Statement. To involve the public in the scoping process, public meetings were held in Great Falls, Montana on 7 February 1980; in Colorado Springs, Colorado on 11 February 1980; and in Albuquerque, New Mexico on 13 February 1980.

This document addresses the environmental issues that were identified through the scoping process as being potential adverse impacts. To a limited extent other areas of concern are discussed in this document (such as climate, geology, soils, etc.) in order to provide a basis for judging which environmental attributes could be potentially impacted.

This document was prepared by a private consulting firm under the supervision of the Air Force Space Division, Frank Meyers - Project Manager, Raphael Roig - Chairperson of the Space Division Environmental Protection Committee, and Colonel John D. Pearman - Director of Civil Engineering.

1. PURPOSE AND NEED FOR ACTION

Currently the Department of the Air Force provides command and control to orbiting spacecraft through the Satellite Control Facility (SCF). The SCF is a worldwide network of seven remote tracking sites and a Satellite Test Center (STC) at Sunnyvale, California. The STC is a single critical control element and vulnerable to possible natural catastrophe or hostile acts. In addition, the SCF workload has increased 125% in the last two years. By 1985 the center will have to support some 65 satellites; at the present time the center supports 40 orbiting satellites. A second facility termed the Satellite Operations Center (SOC) is needed to share the increasing workload and to eliminate dependence on the single control element at Sunnyvale.

In February 1979 the Office of Management and Budget requested the Department of Defense (DOD) and the National Aeronautics and Space Administration (NASA) to evaluate whether a joint mission control center or separate DOD and NASA facilities should be used to meet post-1985 Space Shuttle mission requirements. The result of this evaluation was a recommendation to establish a separate DOD facility that would provide a higher degree of security for military Space Shuttle missions. This facility is henceforth called the Shuttle Operations and Planning Center (or SOPC).

The two mission elements of satellite control (i.e., SOC) and Space Shuttle operations (i.e., SOPC) would be combined for management, operational and economic efficiencies into the Consolidated Space Operations Center (CSOC). The satellite control element of CSOC will perform communications, command and control service functions for orbiting spacecraft. The Shuttle element will conduct Department of Defense Shuttle flight planning, readiness, and control functions. In this capacity it will provide direct mission authority over DOD Shuttle missions; respond to national priorities; and protect national security data.

II. ALTERNATIVES INCLUDING THE PROPOSED ACTION

II.A Description of Proposed Action and Alternatives

The Department of the Air Force proposes to locate the Consolidated Space Operations Center (CSOC) in the Peterson Air Force Base/Colorado Springs area.

The Peterson Air Force Base/Colorado Springs area was selected as the prime candidate because of its unique operational advantages which accrue from its proximity to related activities, namely the Space Defense Operations Center (SPADOC) of the North American Air Defense Command at the United States Air Force Cheyenne Mountain Complex. Proximate location of CSOC and SPADOC would provide a foundation for significant, long-term operational efficiencies stemming from convenient face-to-face planning as well as shared support tasks. In this regard, SPADOC will be able to provide the CSOC with a link into the existing space surveillance and warning structure. The proximate siting of these two functions also offers flexibility to accommodate future, unfolding defense missions in space.

The CSOC will require a new technical facility totalling about 370,000 square feet plus 100,000 square feet of support facilities. An artist's rendering of a typical CSOC facility is presented in Figure 1; variations of this design layout are employed at each of the candidate locations to accommodate local topography and existing facilities. Construction of CSOC is currently planned to begin during Fiscal Year 1982 on one of two possible sites in the Colorado Springs, Colorado area.

When fully operational in mid-calendar year 1985, the CSOC would employ approximately 300 Air Force military personnel, 100 Department of the Air Force civilian personnel, and approximately 1400 contractor personnel. Operational manpower for CSOC would be phased over a three-year period beginning in Fiscal Year 1983, as indicated in Table 1 below. The accompanying base support requirement (for such services as personnel, accounting, civil engineering, etc.) would cause an additional manpower increase of about 120 persons.

Table 1

CSOC Personnel Phase-In

Personnel Category	Fiscal Year			Total
	1983	1984	1985	
Military: Officers	27	29	72	128
Airmen	51	55	84	190
Total Military	78	84	156	318
Civil Service	11	28	72	111
Contractors	119	337	957	1413
Base Support	16	34	71	121
TOTAL PERSONNEL	224	483	1256	1963

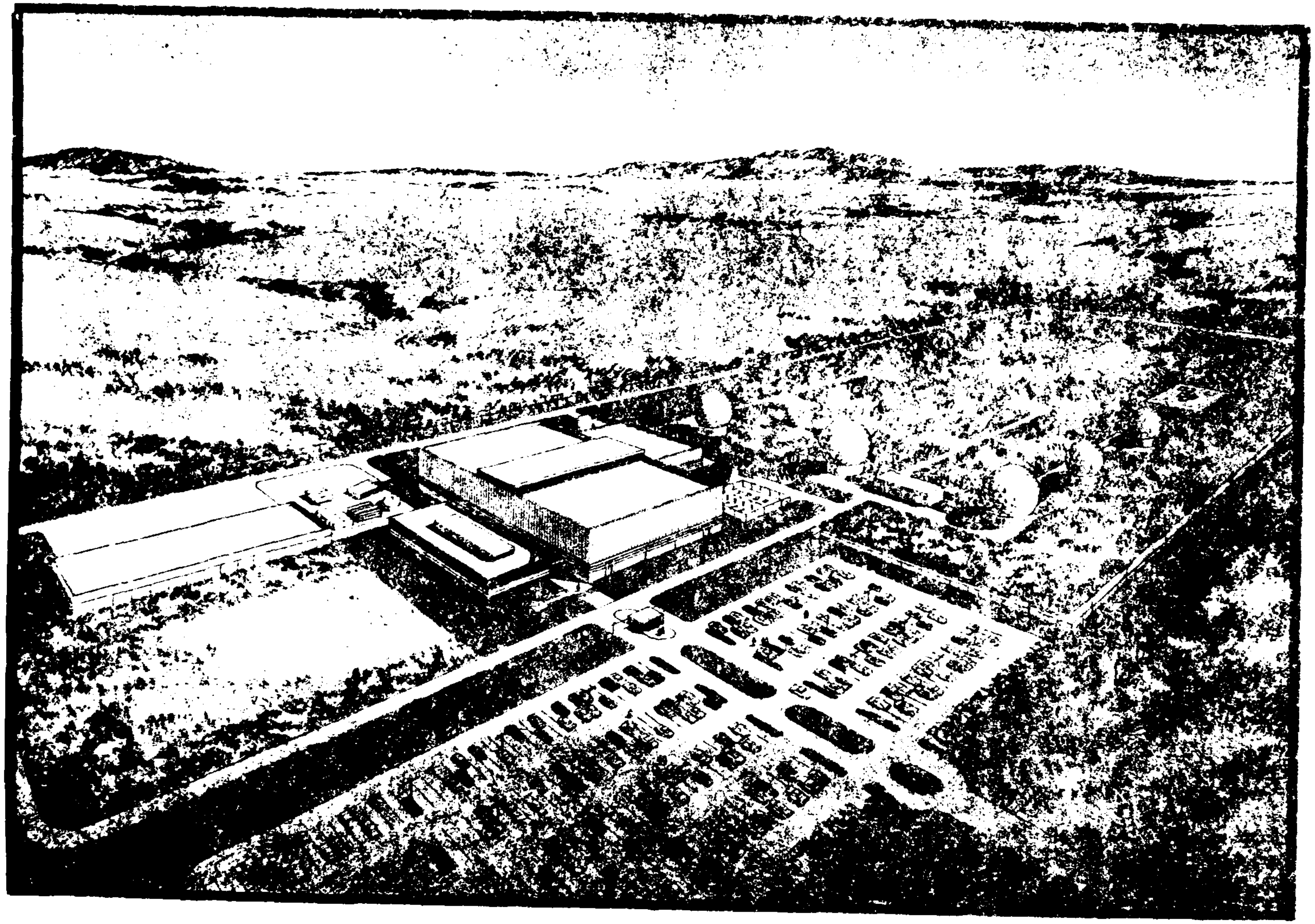


Figure 1 Artist's Rendering of Typical CSOC Facility

For purposes of determining population-related impacts, the total number of CSOC employees was assumed to be about 2000. Using a factor of 3.2 persons per household, the CSOC-generated population was therefore 6,100 additional people at each of the three candidate locations.

The three locations, Peterson AFB/Colorado Springs, Kirtland AFB/Albuquerque, and Malmstrom AFB/Great Falls, were considered as candidate CSOC sites and all meet the basic geographic, technical, support and resource siting criteria. The Colorado Springs location is preferred because of its unique operational advantages. Specifically considered were the effects resulting from geographical proximity of the CSOC with the Space Defense Operations Center (SPADOC). However, Kirtland and Malmstrom AFBs are also evaluated as Alternates 1 and 2 respectively. At Malmstrom, CSOC could be sited on base at either of two locations labeled Options A and B.

II.B The Environmental Consequences of the Proposed Action and Alternatives

The environmental consequences associated with the preferred and alternate locations for the CSOC facility are comparatively presented in Table 2, which lists the impacts by attribute and location. Mitigation measures that are recommended for minimizing the impacts are contained in the following section of this document (see Section II.C).

Table 2

Summary of Environmental and Socioeconomic Impacts

at

Preferred and Alternate Locations

Environmental/Socioeconomic Attribute	Location	~~Environmental~~ Consequences
AIR QUALITY	Colorado Springs	Motor vehicle emissions could increase air pollutants in region by .2%.
	Albuquerque	Motor vehicle emissions could increase air pollutants in region by .14%.
	Great Falls	Motor vehicle emissions could increase air pollutants in region by 1.9%.
	All Locations	CSOC diesel generators each produce 25 lbs/hr particulates, 24.2 lbs/hr sulfur dioxide and 364 lbs/hr nitrogen oxides. These emissions are in compliance with applicable State and Federal regulations.

Continued . . .

Table 2

Summary of Environmental and Socioeconomic Impacts

at

Preferred and Alternate Locations

(Continued)

Environmental/Socio-economic Attribute	Location	Environmental Consequences
UTILITIES	Colorado Springs	CSOC Facility: Water - Extend existing supply line a distance of 2-3 miles Wastewater Treatment - On-site treatment plant to be constructed Natural Gas - Extend existing supply line 6.5 miles minimum (13 miles if supplied by City of Colorado Springs) Electricity - Extend overhead transmission lines 5 miles (additional 6 miles if a second standby power line is desired)
	Albuquerque	CSOC Facility: Water - Extend existing supply line .5 mile (3 miles extension needed if water storage tank is not used instead at antenna field) Wastewater Treatment - On-site treatment plant to be constructed Natural Gas - Extend existing supply line 4 miles Electricity - Extend overhead transmission line 2.5 miles and construct 1 substation
	Great Falls	CSOC Facility: Water - Option A: Extend line 1800' Option B: Extend 3 miles Wastewater Treatment- Extend sewer line 2 miles for Opts. A&B Natural Gas - Opt.A: Extend 3 miles Option B: Extend 2 miles Electricity: Opt.A: Extend line 1.75 miles on-base and 1.5 miles off-base Option B: Extend 1.5 miles on-base and 1.5 miles off-base

Continued . . .

Table 2

Summary of Environmental and Socioeconomic Impacts

at

Preferred and Alternate Locations

(Continued)

Environmental/Socio-economic Attribute	Location	Environmental Consequences
UTILITIES *(continued)*	All Locations	Regional: Adequate water, waste-water treatment capacity, natural gas and electrical power.
ARCHAEOLOGICAL/ HISTORICAL RE-SOURCES	Colorado Springs	Little likelihood of uncovering any historic or prehistoric sites in CSOC locations
	Albuquerque	Several historical sites in close proximity to antenna field. Site #4 is close to proposed access road to CSOC antenna field.
	Great Falls	Little likelihood of uncovering any historic or prehistoric sites in CSOC locations
CONSTRUCTION	Colorado Springs	Grading: Section 24 - Maximum ±10' cuts/fills required for parking lot; ±20' needed for expansion of CSOC in future. Section 26 - Maximum ±5' cuts/fills Roads: Construct 2700' of 24' wide access road (7980' if Sec. 24 is selected). Pave perimeter patrol road. Pave 2.5 miles of Enoch Rd. Right-of-way must be acquired for vehicular access to Section 24. Utilities: Off-site trenching for underground utilities could create temporary nuisance to traffic on public roads. Buildings: Entire CSOC facility would be constructed on Sect. 24 or 26, requiring about 2 years to complete.
	Albuquerque	Grading: Insignificant at Manzano Area; maximum ±5' cuts/fills at antenna field.

Continued . . .

Table 2

Summary of Environmental and Socioeconomic Impacts

at

Preferred and Alternate Locations

(Continued)

Environmental/Socio-economic Attribute	Location	Environmental Consequences
CONSTRUCTION (continued)	Albuquerque (continued)	Roads: Pave 1000' at Manzano Area; pave 1700' in vicinity of antenna field; pave perimeter patrol road around antenna field only. (Manzano Area already has paved security road.) Utilities: On-base trenching for underground utilities including 12,800' of trench for fiber-optics or co-axial cable. Buildings: Construct new Technical and Powerplant buildings only. Construct guardhouse at antenna field only. Rehabilitate 6 existing buildings at Manzano Area.
	Great Falls	Grading: Opt.A-Insignificant in SAGE area, maximum of ±6' cuts at antenna field. Opt.B-More extensive than Opt.A, parking lot will need ±10' cuts/fills. Roads: Opt.A-Reroute base interior roads in SAGE vicinity; construct .5 mile access road to antenna field; pave 3 miles base road; pave perimeter patrol road at antenna field and at SAGE area. Opt.B-Pave 3 miles base road; pave 1600' of access road between antenna field and US 87/89; pave perimeter patrol road; improve access to US 87/89.

Continued . . .

Table 2

Summary of Environmental and Socioeconomic Impacts

at

Preferred and Alternate Locations

(Continued)

Environmental/Socio-economic Attribute	Location	Environmental Consequences
CONSTRUCTION (continued)	Great Falls (continued)	Utilities: Opt.A-On-base trenching for underground utilities and 8700' of fiber optics or coaxial cable Opt.B-On-base trenching for underground utilities only
	All Locations	During grading operations heavy construction equipment would emit 239 pounds per day of pollutants.
VISUAL	Colorado Springs	Antenna structures and CSOC buildings are partially visible from US 94 and to a greater degree from Enoch Road.
	Albuquerque	CSOC facility is not visible from off-base roads and highways, or from residential developments.
	Great Falls	Antenna structures and CSOC buildings are visible from US 87/89 for several miles in either direction, and to a lesser degree from 52nd Street.
ELECTROMAGNETIC RADIATION	All Locations	All emitted radiation is orders of magnitude below 1 mw/cm^2 at ground level; however, power density could be increased due to reflection off other objects which makes it necessary to conduct field survey measurements after antenna installation to identify areas where restricted or prohibited access is necessary. Potential exists to activate EEDs on aircraft flying within 473' of the S-Band antenna. (This potential is greater at Great Falls due to the nearby runway.)
TRAFFIC	Colorado Springs	CSOC traffic could cause delays at the Hwy. 94/Peterson Rd. intersection during peak am and pm hours. Also, peak pm traffic entering Hwy. 94

Continued . . .

Table 2

Summary of Environmental and Socioeconomic Impacts

at

Preferred and Alternate Locations

(Continued)

Environmental/Socio-economic Attribute	Location	Environmental Consequences
TRAFFIC (continued)	Colorado Springs (continued)	from the CSOC site access road could require a traffic control device to enable vehicles to enter the highway safely.
	Albuquerque	CSOC traffic could slightly increase the amount of congestion at two of the five access gates to Kirtland AFB and might require additional traffic control measures.
	Great Falls	Option A: Malmstrom AFB traffic volume at the main gate would be doubled during the peak am and pm hours as a result of CSOC traffic. Option B: Ingress/egress traffic at US 87/89 would need a traffic signal plus other lane improvements. Also, existing pm CSOC traffic could be subjected to substantial delays unless dual exit lanes were provided between the parking lot and a new gate at US 87/89.
PUBLIC SCHOOLS	Colorado Springs	Projected adequate capacity for CSOC students; may be localized areas in Colorado Springs where schools are at capacity.
	Albuquerque	Projected adequate capacity for CSOC students except in certain areas of Albuquerque where rapid growth has caused overcrowding of schools.
	Great Falls	May need to open additional classrooms in certain elementary and junior high schools by 1984; by 1985 the added CSOC students may be sufficient to warrant opening several of the elementary schools which have been recently closed.

Continued . . .

Table 2

Summary of Environmental and Socioeconomic Impacts

at

Preferred and Alternate Locations

(Continued)

Environmental/Socio-economic Attribute	Location	Environmental Consequences
HOUSING	Colorado Springs	• Military - Family quarters and BOQ units have a 2-4 month waiting period. Only 27 BAQ units are vacant at the present time and may or may not be available for CSOC personnel. • Civilian - Adequate number of housing units projected to be available; price range may limit affordable housing for enlisted persons. Influx of CSOC personnel may cause the regional vacancy rate to drop below 2%.
	Albuquerque	• Military - Family quarters and BOQ units have a 1-month waiting period. BAQ units will probably be available for CSOC personnel. • Civilian - Adequate number of housing units projected to be available; price range may limit choices for enlisted personnel. Influx of CSOC families could cause regional vacancy rate to drop below 2%.
	Great Falls	• Military - Family quarters and BOQ units have average waiting period of 3 months. BAQ spaces will probably be available for CSOC personnel. • Civilian - Sufficient housing units projected to be available; price range may limit choice of housing for enlisted personnel. Influx of CSOC personnel should help decrease present vacancy rate of 10%.

Table 2

Summary of Environmental and Socioeconomic Impacts

at

Preferred and Alternate Locations

(Continued)

Environmental/Socio-economic Attribute	Location	Environmental Consequences
GENERAL COST/ REVENUE	Colorado Springs	CSOC population could generate additional tax revenues for regional area including additional federal funds for local school districts. CSOC may generate minor costs to local school districts if classrooms need to be reopened.
	Albuquerque	CSOC population may generate additional tax revenues for regional area including additional federal funds for local school districts. CSOC may generate minor costs to local school district if classrooms are added in certain areas of town.
	Great Falls	CSOC population could generate additional tax revenues (with the exception of sales tax which is not collected in Great Falls) for the regional area, including additional federal funds for local school district. CSOC may generate costs to local school district as classrooms and entire schools are re-opened to accommodate the additional CSOC students.
LAND USE PLANS, POLICIES AND CONTROLS	Colorado Springs	CSOC location is 10 miles beyond the planned growth area for Colorado Springs. CSOC may encourage development of local commercial establishments on Highway 94. CSOC facility will curtail livestock grazing operations on either Sects. 24 or 26.
	Albuquerque	No Impacts Identified
	Great Falls	Either Option A or B would preclude the construction of the Base Golf Course at the antenna field location.

Continued . . .

II.C Mitigation Measures

Mitigation measures proposed to offset any possible environmental impact at the three candidate locations are minimal, since adverse environmental impacts resulting from CSOC are not considered substantial. Only those mitigation measures which the Air Force has authority to implement are proposed. There are other measures which would be beneficial. However, these would require the action or cooperation of other state, local and federal agencies. Because they are outside of the ability of the Air Force, by itself, to implement, they have not been included in this list.

II.C.1 All Locations

1. Incorporating instructions in the grading plans as to the procedure to be used in the event an archaeological/historical find is made. Such instructions should require notification of the State Historic Preservation Officer.
2. Perform field survey measurements after antenna installation to identify areas where controlled or restricted access is necessary.
3. Restrict all air traffic within 1000 feet of the antenna field to avoid possible exposure of electroexplosive devices to antenna radiation.
4. Consider staggered work hours for the CSOC project so as to avoid coinciding with peak am and pm traffic.

II.C.2 Peterson AFB/Colorado Springs Location

1. Consider leasing the remaining portion of Section 26 (or Section 24) adjoining the CSOC fenced complex, to local farmers for livestock grazing or other compatible farming activity.
2. Consider landscaping with trees and shrubs along the west and south property lines of Section 26 to obscure the view of the CSOC facility and antennas from nearby residents and travelers on Enoch Road.

II.C.3 Kirtland AFB/Albuquerque Location

1. Encourage the use of Eubank Gate by CSOC employees during peak am and pm hours at the base in order to reduce the impact on Wyoming, Gibson and Truman Gates and to reduce traffic on Pennsylvania Avenue and Wyoming Boulevard.

2. To extent feasible, route all access roads and other CSOC structures away from already-identified archaeological sites, particularly Site No. 4.

3. Encourage delivery of construction equipment/materials outside peak am and pm hours at the base.

II.C.4 Malmstrom AFB/Great Falls Location

1. Option B: Consider provision of two exit lanes between the CSOC parking lot and U.S. 87/89 to reduce traffic delays during peak pm exiting time.

2. Option A: Encourage delivery of construction equipment/materials outside peak am and pm hours at the base.

3. Option B: Recommend construction traffic access to CSOC be confined to extent possible, to U.S. 87/89 entrance.

II.D Alternatives Eliminated from Further Study

A total of seventeen (17) specific sites at twelve (12) different military installations located throughout the continental United States were surveyed as potential candidates for the CSOC. A site survey (No. 78-21) was conducted in May and November of 1978, and again in January 1979. Site selection criteria was established for the site surveys and were used for evaluating the location of the CSOC. A site evaluation was made for each of the seventeen locations against the site selection criteria. Using the results of these surveys, Malmstrom, Peterson and Kirtland Air Force Bases were selected as the final candidate sites best meeting the criteria. The evaluation and conclusions are contained in the "HQ USAF Report on the Site Selection for the CSOC", dated December 1979.

The Secretary of the Air Force later directed, on 8 August 1979, that the final three candidate sites be re-surveyed. The purpose of this re-survey (No. 79-26) was to 1) update the technical data, 2) determine the impact the CSOC mission requirements would have on each candidate base, 3) perform a preliminary informal environmental analysis, and 4) investigate the potential use of existing facilities to reduce CSOC facility costs. The general conclusions of this survey stated there were no overriding technical, environmental or base support reasons for selecting one site over another, although Kirtland AFB showed the lowest initial estimated military construction costs. This survey additionally included evaluation of Sections 24 and 26 (at the Peterson AFB/Colorado Springs area) for locating the CSOC facility complex. The findings, evaluations and conclusions are included in the aforementioned USAF report on the site selection for the CSOC.

Subsequent to Site Survey 79-26, the three candidate sites were evaluated against operational and organizational factors. This evaluation resulted in Peterson AFB/Colorado Springs being selected as the preferred location for the CSOC. The operational and organizational factors are described in "HQ USAF Report on the Site Selection for the CSOC".

III. AFFECTED ENVIRONMENT

III.A Preferred Location - Peterson AFB/Colorado Springs, Colorado

III.A.1 General Description of Region

The CSOC facility is proposed to be located near the city of Colorado Springs on either of two specific sites located approximately 10 miles east of the city limits. The general location of the two sites with respect to Colorado Springs and other smaller communities in the central Colorado area is shown in Figure 2. Although it is possible that some of the CSOC personnel will elect to reside in communities other than Colorado Springs, the distribution of personnel and their families cannot be predicted with any reasonable degree of accuracy. For purposes of this report it is assumed therefore that all of the CSOC population will reside in the Colorado Springs urban area.

Colorado Springs is the principal node of activity and urban development in El Paso County. It is also Colorado's second largest city, with a reported population of about 230,000 in May 1979. The entire population of El Paso County is estimated to be about 333,000; Colorado Springs therefore contains approximately seventy percent of the total county population.

Both Colorado Springs and El Paso County are within a regional area referred to as the 'Pikes Peak Region', so-named because of nearby Pikes Peak immediately west of the city. Colorado Springs is located at the foot of the eastern slope of the Rocky Mountains (referred to as the Front Range), and is known for its moderate summer weather, clear sunny days and dry winter climate.

As Colorado Springs has grown it has matured into a city of arts, museums, libraries, music centers, fine restaurants and abundant year-round recreational activities. There are over 250 churches representing 50 denominations. A number of higher educational institutions, including the University of Colorado, the United States Air Force Academy, Colorado College, and Pikes Peak Community College, are located in the immediate area. There are nine hospitals in the county which specialize in general care, psychiatry, osteopathy, and cancer research and treatment.

III.A.2 General Description of the CSOC Sites

The Air Force is considering one of two specific sites east of Colorado Springs for the CSOC facility location. Their location is about 10 miles east of the city limits, and 1-2 miles south of Highway 94. The sites under consideration are Sections 24 and 26 of Range 64 West Township 14 South; Section 26 adjoins the east side of Enoch Road and Section 24 is one mile further east at the northeast corner of Section 26. These two sections are portions of a larger block of land which was put under state ownership by the federal government when Colorado became a state in 1876. The sections are undeveloped and are occasionally used for livestock grazing. Other than three farmhouses on property adjoining the south and west property lines of Section 26, there are no other inhabited dwellings on property adjoining either section of land. A small subdivision called the Rolling Hills Ranch Estates is located northeast of Section 24 and will probably be developed by the respective lot owners at some time in the future.

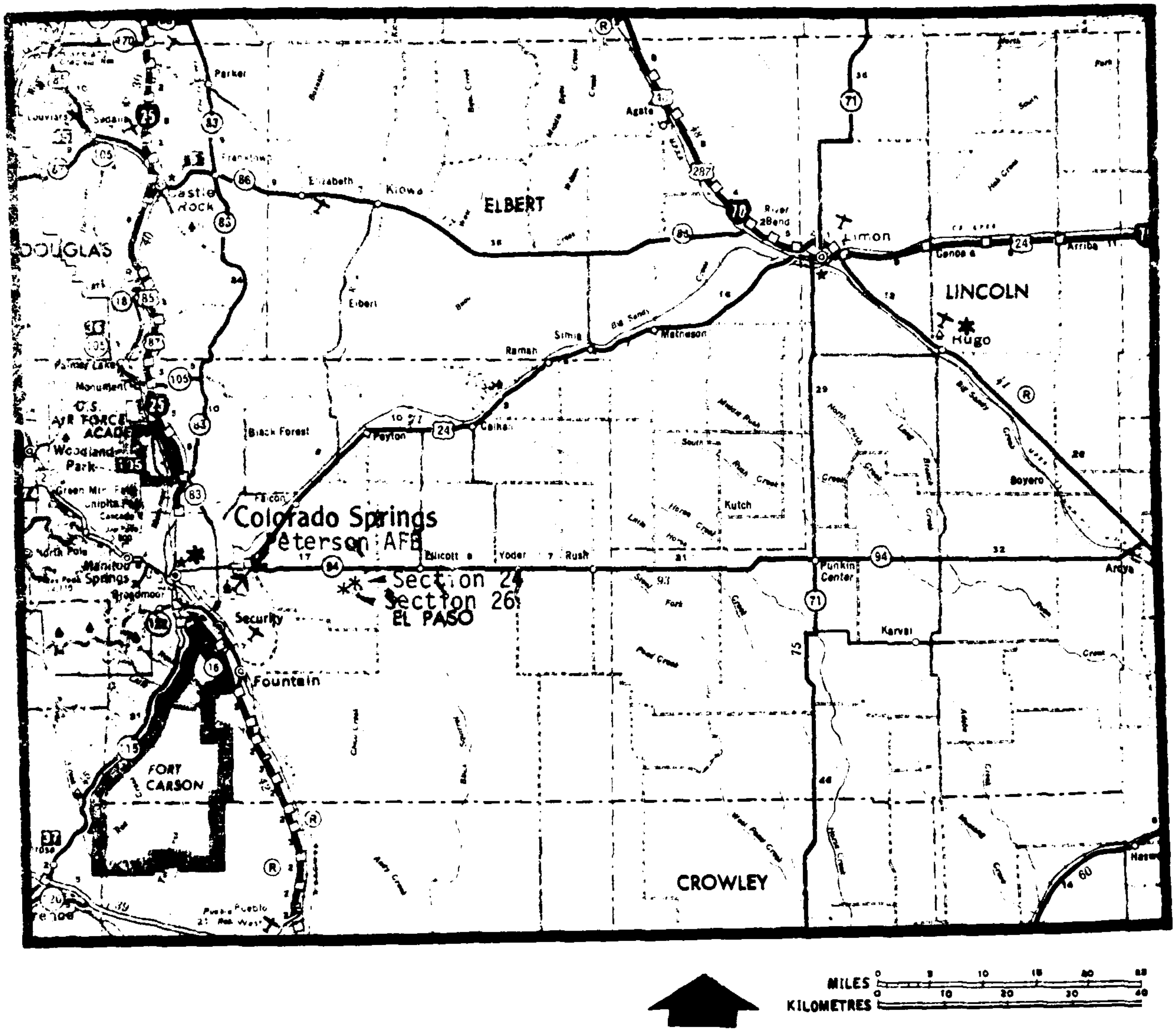


Figure 2 Vicinity Map for Peterson Air Force Base/Colorado Springs Location

The CSOC preliminary site plan for each section of land is presented in Figures 3 and 4. Initially only 5 antennas would be installed at the site as indicated by the solid black dots. Additional antennas would be placed on site in the area designated "Antenna Field Expansion". The site plans are different due to the topographic variations on the two sections, particularly the existence of the natural drainage courses on Section 26 and the steeper terrain on Section 24.

Several ranches and small farms are the predominant land use in the vicinity. A coal mining operation has recently been approved in the area south of Highway 94 off of Franceville Road (three miles west of the CSOC sites); mining will begin this year.

III.A.3 Existing Traffic Environment (AFERN 4.4.1.2)

Roads and highways which will be affected by the proposed facility and its employees include State Highway 94, Enoch Road, and the intersection of Highway 94 with Peterson Road.

Highway 94 is a two lane paved road which is the only direct access to the CSOC site. Various sections of this highway between Colorado Springs and Ellicott are being improved by the State; improvements consist of paving the graded shoulders, capping the existing 11-foot wide travel lanes, adding a passing lane in the vicinity of Franceville Road (to minimize traffic congestion resulting from the coal-mining operation), and replacing the substandard timber bridges over streams and washes with concrete and steel structures. Improvements up to Enoch Road are planned for Fiscal Year 1981; the entire program is to be completed by July 1982. If a final decision on the CSOC facility is available by the end of 1980, the State Highway Department has indicated that intersection improvements in the vicinity of Enoch Road could be included in their budgeted program. These improvements would consist of a left turn lane and an acceleration lane.

The latest available traffic counts on Highway 94 are presented in Figure 5. In the vicinity of Enoch Road the traffic is 1200 vehicles per day; proceeding west towards Colorado Springs the traffic increases to 2300 vehicles per day at Marksheffel Road. A recent truck count taken by the State Highway Department indicated that truck traffic in the vicinity of Marksheffel Road amounted to 2.4% (or 56 trucks per day) of the daily traffic on Highway 94. The major influx of traffic entering Highway 94 occurs at Peterson Road which is the main entry road to the air force base. Average weekday traffic at this location increases from 3000 vehicles per day east of Peterson Road to 13,000 west of Peterson Road. A major portion of this traffic is generated during the peak base hours of 7-8 am and 4-5 pm, when approximately 4100 vehicles ingress/egress the base.

Enoch Road is an unpaved local County road with a 60-foot right-of-way and 30 feet of graded travelway; the road has been maintained in excellent condition. It terminates at Highway 94 and is the main route for farmers residing south of Highway 94 to reach Colorado Springs. Traffic on Enoch Road in the vicinity of the proposed CSOC facility is currently less than 100 vehicles per day.

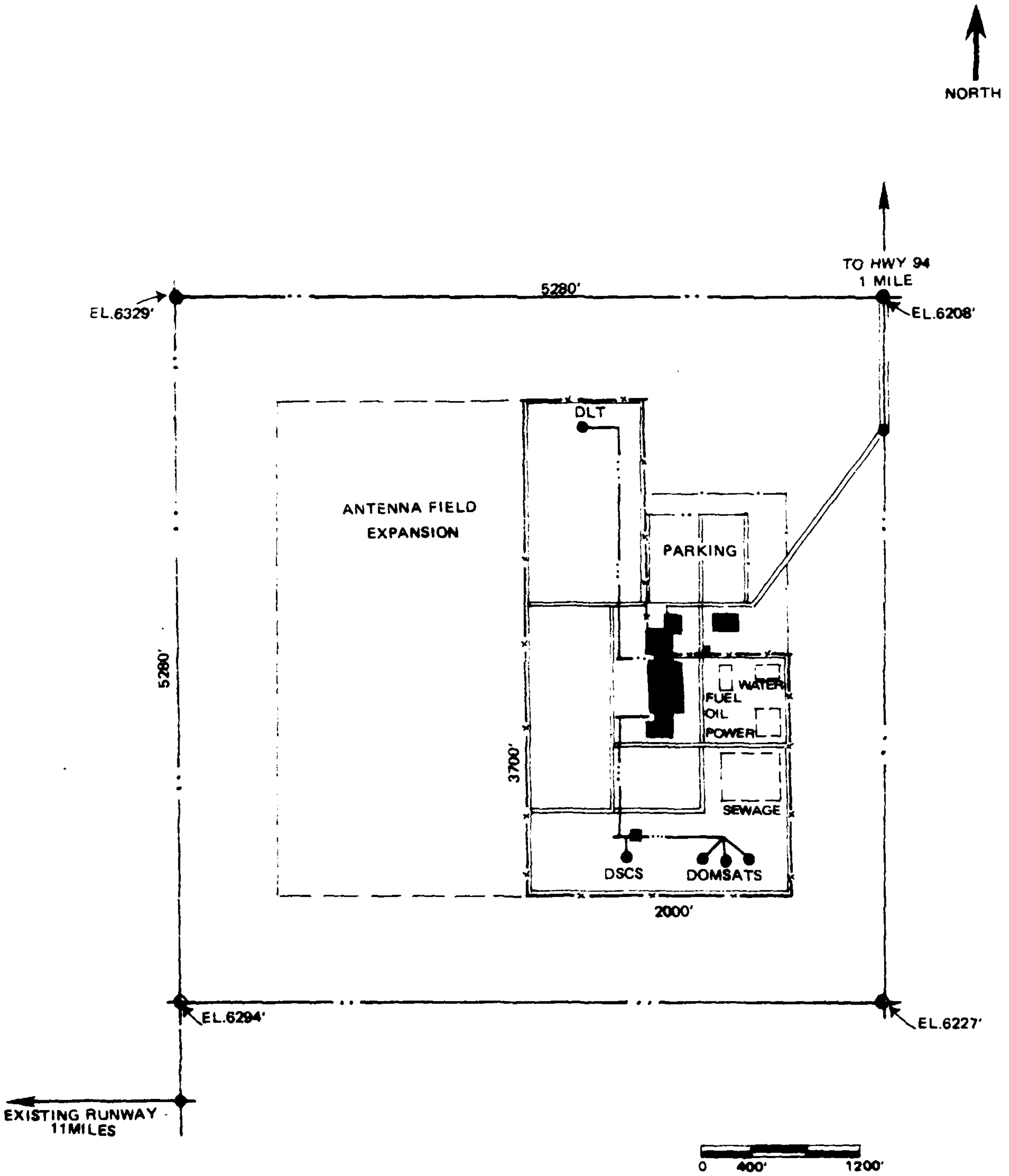


Figure 3 CSOC Configuration on Section 24 at Peterson AFB/Colorado Springs Location

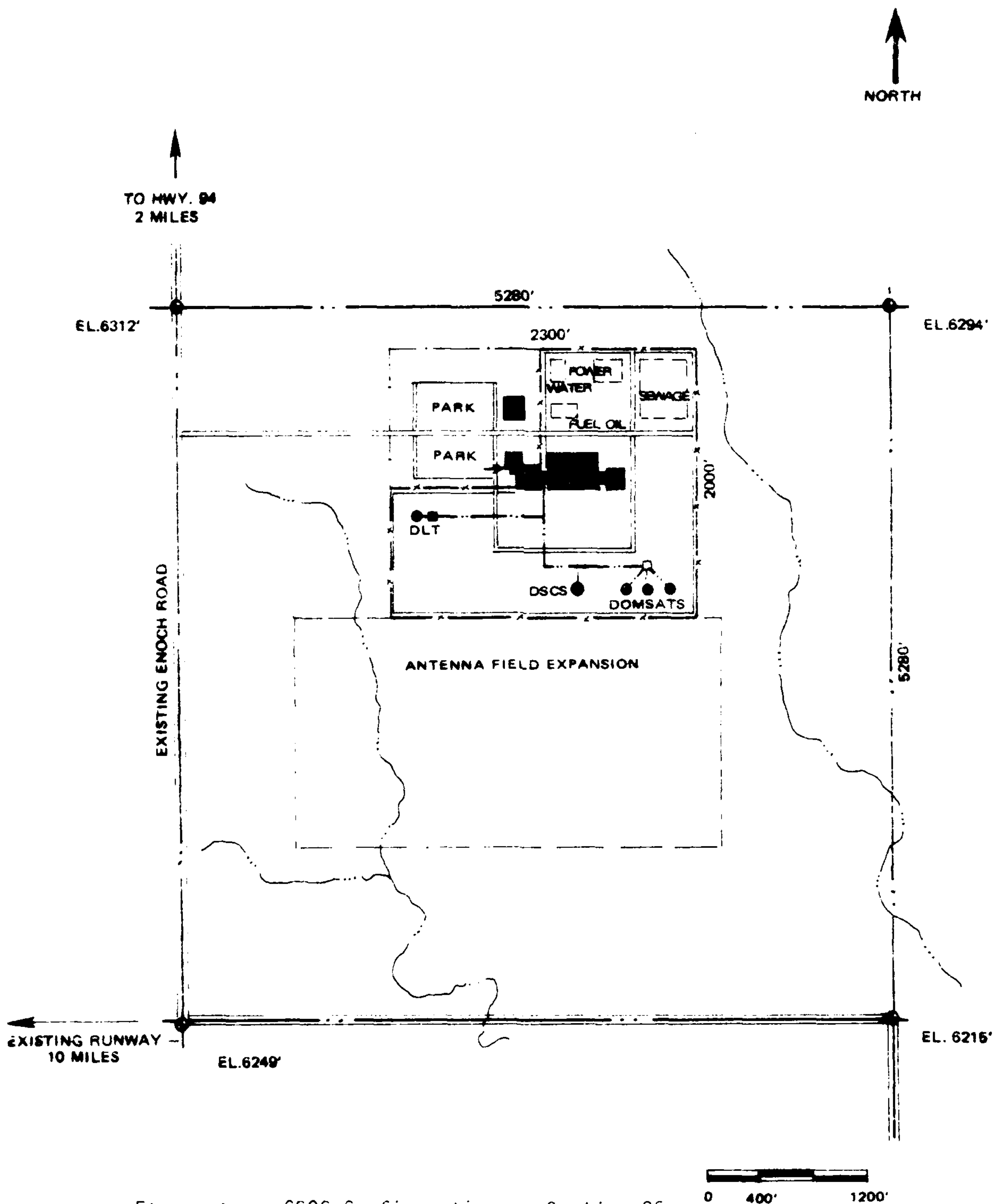
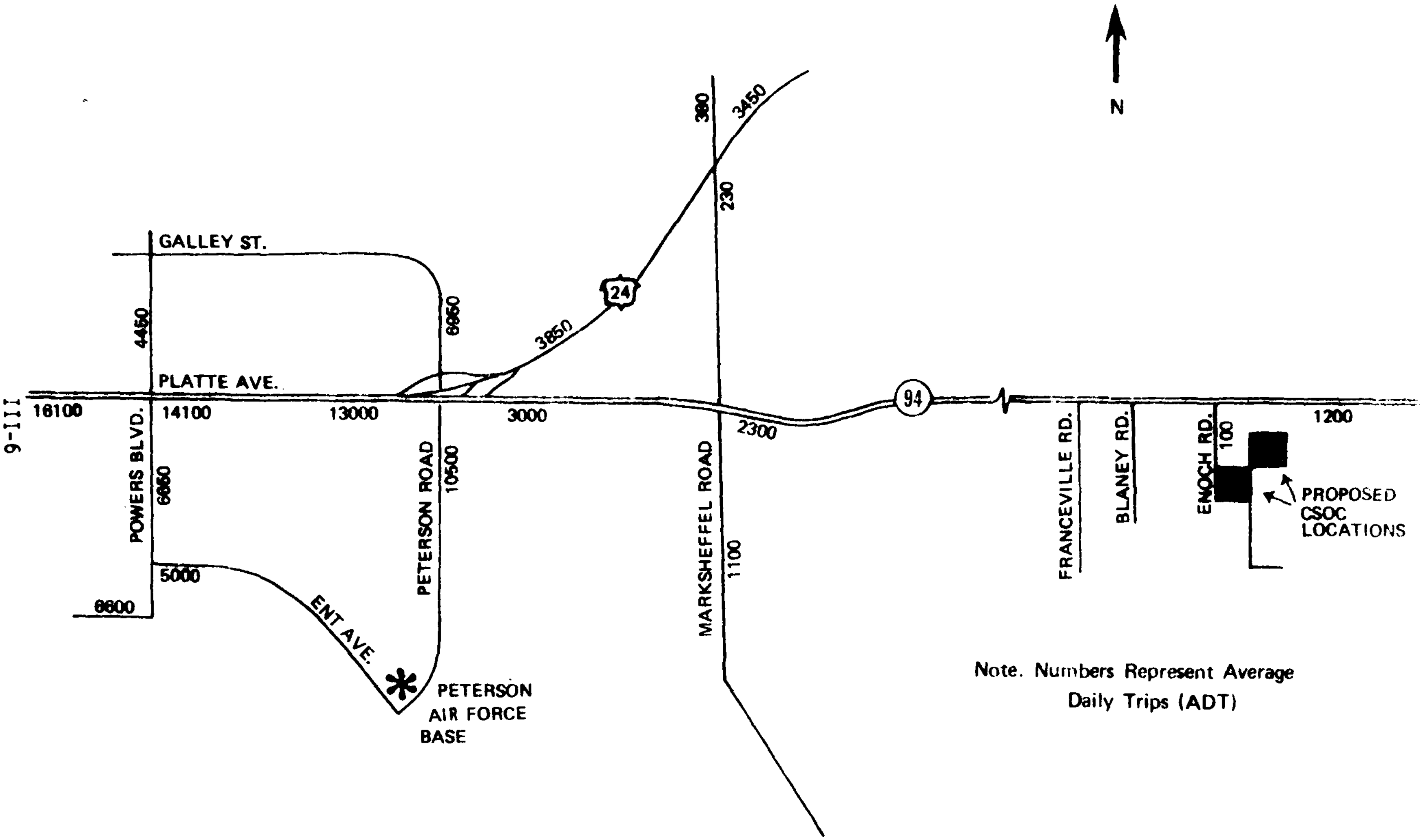


Figure 4 CSOC Configuration on Section 26 at Peterson AFB/Colorado Springs Location



Note. Numbers Represent Average Daily Trips (ADT)

Figure 5 Current Traffic Counts on Roads Affected by CSOC Traffic in Peterson AFB/Colorado Springs Area

A coal mining operation south of Highway 94 on Franceville Road began operation in the first part of 1980. At full operating capacity, 150 loaded trucks per day will enter the highway at Franceville Road heading west towards Colorado Springs; these trucks will return to the site unloaded. This truck traffic is in addition to the traffic counts presented in Figure 5.

The above paragraphs describe those roads and highways that will be impacted by CSOC employee traffic. Based on the assumption that the majority of CSOC employees will reside in the urbanized area of Colorado Springs, roads and highways throughout the city will be used for daily vehicular trips. For purposes of this analysis, however, it is predictable that the roads most impacted will be those connecting the north and south sections of the city with Highway 94. A number of road improvement projects are scheduled to take place throughout the city, but those that are deemed to be relevant to this project are the 1980-1990 improvement of Powers Boulevard to a 4-lane expressway with controlled access. Powers Boulevard is a north/south route in the vicinity of Peterson Air Force Base, connecting with Highway 94. It will provide improved access between the base, Highway 94 and residential areas in the north and south parts of the city. It should also relieve the present congestion at Peterson Road and Highway 94/State Highway 24. In the long-range highway improvement plan (beyond 1990), a major by-pass route around Colorado Springs is planned. This by-pass is proposed to be located somewhere in the neighborhood of 4 miles west of Enoch Road.

Public transportation is provided by the city of Colorado Springs in the form of buses. Although the bus mode accounted for only 1.5% of home-to-work commuting in 1975, bus ridership has generally exhibited a strong upward trend in recent years. This trend is expected to continue particularly in light of increased gasoline prices. The city is presently reassessing its transit routes and is adding additional buses to the system. In addition, a carpool locator service for the Colorado Springs urban area was put into operation in January 1979. Both the added bus service and the carpool locator service are part of the city's efforts to bring the Colorado Springs area into compliance with Federal air quality standards by 1987.

III.A.4 Existing Air Quality Environment (AFERN 3.3)

El Paso County encompasses an area of about 40 miles by 54 miles. Much of the county including the area where CSOC is proposed to be sited, is currently in compliance with air quality standards; the primary area of concern with respect to air quality is the urban area in and around Colorado Springs. Outside of this urban area the most significant sources of air pollutants are agricultural activities to the east (where the CSOC sites are located), military training operations to the south, and naturally-occurring dust from all along the semi-arid plains lying east of the Rocky Mountains.

The Colorado Springs urban area (which is located in an Air Quality Maintenance Area) has been designated as a non-attainment area for its violations of the Federal ambient air quality standards for carbon monoxide, suspended particulates, and (until recently) ozone. The area has been in violation of the suspended particulate standard (75 $\mu g/m^3$) since 1972. The 8-hour carbon monoxide standard of 9 ppm was violated 4 times in 1975, 10 times in 1976, 1 time in 1977, and 7 times in 1978. There were no violations of the 1-hour carbon monoxide standard (35 ppm) in 1978. Both the Colorado Springs Air Quality Maintenance Area (AQMA) and the remainder of El Paso County have

been designated non-attainment for ozone; however, the standard has recently been changed from .08 ppm to .12 ppm. With this new standard, neither Colorado Springs or El Paso County as a whole, are in violation. The Environmental Protection Agency has been requested to amend the status of the Colorado Springs Air Quality Maintenance Area and El Paso County to reflect compliance with the new ozone standard. Air quality standards for oxides of nitrogen, sulfur dioxide and lead have not been violated in the region to-date.

The State and Federal Air Quality Standards are presented in Table 3. Primary standards are those which are intended to protect the public health; secondary standards are designed to protect the public from other adverse air pollution effects such as damage to vegetation and other materials, and degradation of aesthetic qualities.

Table 3

State and Federal Ambient Air Quality Standards for Colorado

Pollutant	Federal Primary Standard	Federal Secondary Standard	State Adopted Standard
Total Suspended Particulates			
24-Hour Average	260 $\mu g/m^3$*	150 $\mu g/m^3$	Same as Federal Standards
Annual Geometric Mean	75 $\mu g/m^3$	60 $\mu g/m^3$	
Sulfur Dioxide			
24-Hour Average	.14 ppm**		
Annual Arithmetic Average	.07 ppm		
3-Hour Average	----	.5 ppm	.27 ppm
Carbon Monoxide			
8-Hour Average	9 ppm	9 ppm	Same as Federal Standards
1-Hour Average	35 ppm	35 ppm	
Photochemical Oxidants			
1-Hour Average	.12 ppm	.12 ppm	.12 ppm
Nitrogen Dioxide			
24-Hour Average			
Annual Arithmetic Average	.05 ppm	.05 ppm	.05 ppm

*$\mu g/m^3$ - micrograms per cubic meter
**ppm - parts per million

III.A.4.1 Total Suspended Particulates (AFERN 3.3)

The Colorado Springs AQMA 1974 emissions inventory for total suspended particulates is summarized in Table 4. Point sources included in this inventory are those which produce 25 tons per year or more. (Note: 1974 is the latest data available.)

Table 4

1974 Total Suspended Particulates for Colorado Springs AQMA and El Paso County

Sources	Col.Sprgs. AQMA (Tons/year)	% of Total	El Paso Cnty. (Tons/year)	% of Total
Point Sources				
Rock Crushers	408	2.2	---	---
Powerplants	194	1.1	---	---
All Others	254	1.4	---	---
TOTAL POINT SOURCES	856	4.7	---	---
Area Sources				
Residential Fuel	953	5.2	1150	1.4
Motor Vehicles	1005	5.5	1103	1.3
Unpaved Roads	8376	46.2	53231	66.7
Paved Roads	5142	28.3	5642	7.1
Agriculture	---	---	13293	16.7
Land Development Activities	636	3.5	3663	4.6
All Others	1201	6.6	1751	2.2
TOTAL AREA SOURCES	17313	95.3	79833	100.0
TOTAL POINT AND AREA SOURCES	18169	100.0	79833	100.0

Ref.: "Air Quality Maintenance Plan for the Colorado Springs Urban Area and El Paso County," Pikes Peak Area Council of Governments, September 12, 1979.

The major source of total suspended particulates (TSP) is unpaved roads (46% in the Colorado Springs AQMA and 67% in the county as a whole). Vehicle-related sources (including motor vehicles and paved and unpaved roads) account for 80% of the particulate emissions in the Colorado Springs AQMA. Not surprisingly, fugitive dust from unpaved roads and agricultural operations is greater in the county than in the urbanized Colorado Springs area. The above data emphasize the need to minimize vehicle travel on unpaved roads. Table 5 includes a 1985 projection of total suspended particulates for the Colorado Springs AQMA; what is of note is that traffic-related emissions (including mobile source fuel combustion, and paved/unpaved roads) amounts to 50% of the total in 1980 and is expected to increase slightly to 52% by 1985. As part of the State Implementation Program (SIP) for the Colorado Springs AQMA, four control measures have been selected to reduce total suspended particulates. These measures are:

1. Modified Street Sanding Program
   - Reduce amount of sand applied per mile of street
   - Reduce number of miles of street sanded
   - Employ improved street sweeping procedures
2. Control of Mud and Dirt Carryout Sources
   - Permit is now required from the Air Pollution Control Division when more than five acres are to be graded
3. Program for Paving of Unpaved Roads and Alleys
   - Pave equivalent of 11.5 miles of road and 37 miles of alleys
4. Control of Grading Operations
   - On grading of two acres or more, emissions during grading are limited to 50% of the uncontrolled emissions.

Table 5

1980 and 1985 Total Suspended Particulates

in

Colorado Springs AQMA

Source	Percent of Total 1980	1985
Background	31	28
All Point Sources	2	2
Fuel Combustion (Stationary Sources)	10	9
Fuel Combustion (Mobile Sources)	7	6
Paved Streets (Including Sanding)	40	37
Unpaved Roads	3	9
Other Area Sources	7	9
TOTAL	100	100

*Ref.: "Air Quality Maintenance Plan for the Colorado Springs Urban Area and El Paso County." Pikes Peak Area Council of Governments, September 12, 1979.

III.A.4.2 Carbon Monoxide and Ozone (AFERN 3.3)

The primary source of carbon monoxide emissions and hydrocarbons (the precursor of ozone) is the automobile. Newly-manufactured vehicles are now required to meet Federal EPA standards for carbon monoxide, hydrocarbons and oxides of nitrogen.

The predominant source of carbon monoxide emissions is the primary and secondary traffic which accounts for over 93% of the total emissions, refer to Table 6 below. Primary traffic consists of vehicles on the arterial roads; secondary traffic is that occurring on all low-volume streets, roads and alleys. It is clear that any significant reduction in carbon monoxide emissions will be highly dependent on transportation control measures that will reduce the emission rates or use of the motor vehicle, or both.

Table 6

1974 Carbon Monoxide Emissions

for

Colorado Springs AQMA

Source	Tons per Year	Percent of Total
Vehicular Sources		
Primary	166,200	
Secondary	35,899	
	202,099	93.3
Stationary Sources		
Coal	18	
Oil	19	
Natural Gas	180	
Other Fuels	1,595	
Incinerators	1	.9
	1,813	
Other Mobile Sources		
Off-highway Vehicles	5,903	
Railroads	83	
Aircraft	6,439	
	12,425	5.8
TOTAL	216,337	100.0

*Ref.: "Air Quality Maintenance Plan for the Colorado Springs Urban Area and El Paso County." Pikes Peak Area Council of Governments, September 12, 1979.

NOTE: 1974 is latest data available.

Despite a predicted increase in areawide traffic of 29% between 1977 and 1982, the Federal motor vehicle emissions control program is expected to attain a 30% reduction in the maximum eight-hour concentration of carbon monoxide. Even with this sizable reduction, however, the Federal carbon monoxide standard would not be achieved by 1982 without additional control measures. The following control measures for the Colorado Springs AQMA are designed to achieve the Federal standard by 1987:

1. Carpool Matching Service
    - Includes several employer-based carpool and vanpool programs
2. Air Quality Planning
    - Long-range planning process relating air quality, transportation, land use, water quality, and other types of environmental planning
3. Improved Transit Services
    - Expansion of present bus fleet
    - Additional bus routes
    - Increased frequency of service
4. Miscellaneous Transportation System Improvements
    - Areawide bikeways plan is being prepared
    - Feasibility of staggered work hours is being studied
    - Four day workweeks are being studied
    - Improve existing traffic control systems
5. Automotive Inspection and Maintenance (I/M) Programs
    - Applies to 1972 and later vehicles
    - A feasibility study of I/M on 1968-71 vehicles is in process
6. Public Education Program

Additional control measures are presently under consideration as required by the EPA. These include, but are not limited to the following:

- Vapor Recovery
- On-Street Parking Controls
- Bicycle Lanes and Storage Facilities
- Modified I/M
- Mandatory Employer Programs
- Staggered Work Hours

The following control measures have been selected for analysis as an integral part of the long-range planning process for Colorado Springs:

- Exclusive bus and carpool lanes
- Long-range transit improvements
- Pedestrian Malls
- Park and Ride fringe parking lots
- Traffic flow improvements
- Land Use planning and regulation
- Private car restriction
- Road pricing to discourage single-occupancy trips

Ozone concentrations are produced in the chemical reaction between airborne oxides of nitrogen and volatile hydrocarbons. A reduction in the hydrocarbon concentrations will therefore also reduce ozone concentrations. Hydrocarbon emissions can be substantially reduced through a reduction in the emission rates (of motorized vehicles) and/or a reduction in the use of motor vehicles. The maximum ozone concentrations measured in 1976 and 1977 in the Colorado Springs AQMA were .100 and .085 ppm respectively. It is anticipated that the Colorado Springs AQMA will be removed from non-attainment status with respect to ozone.

The hydrocarbon emissions data for 1977, and projections for 1982 and 1987 are presented in Table 7.

Table 7

Hydrocarbon Emissions in Colorado Springs AQMA

Source	Tons per Year 1977	1982	1987
Vehicles	18,809	15,189	10,294
Large Point Sources	5,118	5,937	6,858
Small Point Sources	64	74	86
Vapor Losses from Gasoline Handling	2,520	3,263	4,008
Total from all Sources	26,511	24,074	21,246

*Ref.: "Air Quality Maintenance Plan for the Colorado Springs Urban Area and El Paso County." Pikes Peak Area Council of Governments, September 12, 1979.

The control measures outlined previously in this section that are intended to reduce the carbon monoxide emissions will also reduce hydrocarbon emissions, and in turn limit the production of ozone.

III.A.5 Utilities (AFERN 4.4.2.1)

Utility demands would be generated by both the CSOC facility east of Colorado Springs, and by the CSOC households throughout the Colorado Springs urbanized area. The present and anticipated utility service capabilities will be described as they relate to both the CSOC facility and CSOC residential demands. In addition, the 'worst case' situation wherein all of the CSOC employees are new to the area, will be assumed even though it is probable that many of the CSOC employees would be drawn from the local labor market. Also not considered in this analysis are the population reductions likely to occur with the ADCOM realignment prior to Fiscal Year 1983, which could result in approximately 1300 employees and their families leaving the Colorado Springs area.

III.A.5.1 Water Resources (AFERN 4.4.2.1)

Colorado Springs receives its potable and non-potable water supply from a variety of sources, more than half of which is imported from the western slopes of the Rocky Mountains, 38% from surface water sources within the county, and 9% from groundwater basins. Due to the high cost of imported water, agricultural users which use about 95% of the state's water, are presently implementing conservation and re-use methods. Residential users who use about 3% of the available water, are also being encouraged to conserve water particularly in their landscape irrigation practices.

At the present time the average annual water supply to the city is 89,500 acre-feet. Current consumption of potable water is only 55,000 acre-feet or 83% of the total 66,200 acre-feet available. Based on a city population of 230,600 and including residential, commercial and industrial customers, the per capita consumption rate is 213 gallons per day; residential consumption alone is only 110 gallons per day per person.

The developed and undeveloped sources of water for Colorado Springs are listed in Table 8. Total annual water supply available within the next decade is 137,700 acre-feet, sufficient to serve a population of 500,000 - 550,000.

Table 8

Developed and Undeveloped Annual Water Supply for Colorado Springs

Source	Potable Supply (acre-feet)	Non-Potable Supply (acre-feet)
Developed Sources		
Pikes Peak	12,000	
Northfield	600	
South Suburban-Rosemont	4,100	
Pinello Ranch	1,400	
Hanna Ranch		4,600
Blue River Project	11,900	
Blue River Project Reuse		5,100
Homestake Project - Phase I	13,400	
Homestake Project Reuse - Phase I		7,600
Twin Lake Project	22,800	
Twin Lake Project Reuse		13,000
Monument Creek		1,000
Less Returned Flow Reserved for Exchange		-8,000
TOTAL DEVELOPED SOURCE SUPPLY	66,200	23,300
Undeveloped Sources		
Twin Lakes Project (Proxy Group)	4,300	
Twin Lakes Project Reuse (Proxy Group)		2,400
Fryingpan-Arkansas Project	12,900	
Fryingpan-Arkansas Project Reuse		7,400
Homestake Project - Phase 2	10,800	
Homestake Project Reuse - Phase 2		6,200
Eagle-Arkansas Project	2,700	
Eagle-Arkansas Project Reuse		1,500
TOTAL UNDEVELOPED SOURCE SUPPLY	30,700	17,500
TOTAL DEVELOPED & UNDEVELOPED SUPPLY	96,900	40,800
	137,700	

Ref.: "City of Colorado Springs Total Average Annual Water Supply Developed and Undeveloped Resources in Acre-Feet," Dept. of Public Utilities, Colorado Springs, Colorado, February 1979.

In the vicinity of the proposed locations of the CSOC facility there are several sources of water. One is the underground water basin - the Dawson aquifer - which is estimated to contain about 38 million acre-feet in the upper 500 feet of saturated thickness. Groundwater level underlying the area around the CSOC facility is about 6,200 feet MSL, which means that the water table is about 100-150 feet below the surface. The total dissolved solids concentration is reported to be about 100-300 milligrams per liter; fluoride concentration amounts to less than 1 milligram per liter, and dissolved iron is less than .3 milligrams per liter (Ref.: "Water Resources, El Paso County, Colorado", Colorado Water Resources Circular No. 32, 1976).

The second source of water is domestic water that can be provided by private water companies including the Cherokee Water District or the Pikes Peak Water Company. Both of these suppliers have water lines within several miles of Sections 24 and 26. Cherokee's water line is in the right-of-way on Highway 94; Pikes Peak Water Company's line is in Drennan Road three miles south of Section 26. Both draw their water from the Upper Black Squirrel Creek Basin located in the Ellicott area; this underground basin reportedly contains 350,000 acre-feet of water. The Cherokee Water District has the capacity to deliver approximately 6,250,000 gallons per day. It presently supplies water to the Cimarron Hills area in the northeast section of Colorado Springs. Present customer demand is for 350,000 gallons per day in the winter increasing to 2,700,000 gallons per day in the summer. The Pikes Peak Water Company is permitted to export 840 acre-feet annually from the Upper Black Squirrel Creek Basin; however, present customer demand (by the communities of Security, Widefield and Stratmoor Hills in the Colorado Springs area) is for only 780 acre-feet per year. This demand will decrease to about 580 acre-feet per year when the Fryingpan-Arkansas project is completed in the 1983-1985 period. The remaining surplus of 260 acre-feet per year (equivalent to 232,000 gallons per day) could then be available to meet the needs of the CSOC facility.

III.A.5.2 Wastewater Treatment Facilities (AFERN 4.4.2.1)

The city of Colorado Springs and several adjoining communities are served by the Public Utilities Department of Colorado Springs. Present treatment capacity is 42 million gallons per day (mgd); however, annual flows have averaged only about 24-26 mgd for the past several years. The city's regional treatment plant meets all of the current state and EPA requirements with respect to discharge and operational procedures. It is anticipated, however, that by 1982 the plant will be able to handle only about 80% of the treated sludge. Colorado Springs has therefore undertaken a long-range sludge management program designed to handle municipal sludges to the year 2000 at a minimum. The plan calls for disposal of sludge at the Hanna Ranch site (5000 acres located 25 miles south of Colorado Springs) by both land disposal and land application methods. Additional emphasis has also been given to reuse of wastewater after secondary treatment. Two methods of reuse appear feasible: 1)landscape irrigation and industrial use (primarily process manufacturing and cooling water), and 2) industrial use at municipal steam-powered electric generating plants.

Based on the present population of 230,600 in Colorado Springs, the wastewater treatment rate is about 113 gallons per day per person. On this basis, the projected population of 550,000 persons by the year 2000 will require a treatment plant capability of 62 mgd; the capability of the city's treatment plant will have to be expanded to meet this need.

Due to the distance of the CSOC facility from the city's sewage treatment plant, an extended aeration activated sludge treatment plant with evaporative ponds is to be constructed at the CSOC site. The applicable laws, regulations and guidelines governing the proposed facility are primarily handled by the State Water Quality Control Commission. Their areas of jurisdiction include:

- Regulations for effluent limitations
- Regulations prohibiting the operation of a sewage treatment works for which a Site Approval has not been obtained
- Regulations for the State Discharge Permit System
- Guidelines for construction of sealed evaporative and retention ponds

In addition to the above, the Colorado Department of Health has regulations which require certification of the treatment plant and the plant operators. The areawide Water Quality Management Plan (Project Aquarius) must also be updated to include the proposed CSOC treatment plant. This must be done through the noticed public hearing process, and must be completed prior to application for any of the abovementioned permits. The plan is updated on an annual basis. Since construction of the CSOC will not start before April 1982, there is sufficient time to apply for inclusion in the areawide plan.

III.A.5.3 Natural Gas Supply (AFERN 4.4.2.1)

Colorado Interstate Gas Company is the prime supplier of natural gas for the Colorado Springs area. In the recent past yearly consumption rates in Colorado Springs have averaged between 20.1 and 20.7 million cubic feet per day. Allocations to the city from Colorado Interstate Gas Company are based on a 'peak day' demand; the specific amount allocated to Colorado Springs is 180 million cubic feet. The peak day consumption has never exceeded 70 million cubic feet to-date. Although Colorado Interstate Gas can meet the annual demand, it should be understood that they are not able to supply an amount in excess of the 180 million cubic feet peak allocation.

Peoples Natural Gas Company is a retail division of Northern Natural Gas headquartered in Omaha, Nebraska, and serves the area immediately east of Colorado Springs. Peoples' closest existing line to the CSOC facility is in the vicinity of Marksheffel Road and Drennan Road, about 6.5 miles southeast of Section 26. The Colorado Springs Public Utilities Department has a gas line which presently terminates at Marksheffel Road and Highway 24, 13 miles northwest of the CSOC location.

III.A.5.4 Electrical Power Supply (AFERN 4.4.2.1)

Colorado Springs receives its electrical power from the city's three operating coal-fired powerplants, supplemented with hydroelectric power provided by the Colorado River Storage project (and delivered by the Western Area Power Administration - WAPA). Present generating capacity is 600 MW in the summer and 635 MW in the winter. Current service area population is about 250,000 persons. The Public Utility Department has projected an annual growth rate of 3% over the next decade. By 1988 additional power generation is forecast to be needed to serve a projected population of 326,000. The Department is planning to meet this demand by adding another 300-500 MW unit to the Nixon plant. With this additional unit and the long-term availability of supplemental power from WAPA, total generating capacity in 1988 is estimated to be 900 MW minimum.

The location of the CSOC facility is within the Mountain View Electric Association, Inc. service area. Their 115,000-volt line is 5 miles west of CSOC. Capital improvement plans for 1980 include installation of a 69,000-volt overhead transmission line connecting the company's Ellicott substation to the Falcon substation in northeastern Colorado Springs. This line will pass 6 miles north of the CSOC facility and could also be used to supply power to CSOC. Both transmission lines are independent of each other so that a power outage in one line does not affect the other line.

III.A.6 Archaeological/Historical Resources (AFERN 4.4.3.7.3)

El Paso County was recently inventoried for historic sites and structures through a grant by the Colorado Department of Local Affairs. The High Plains area comprising the eastern portion of El Paso County was one of the primary areas inventoried. No historic sites were located on the specific areas of land identified for potential location of the CSOC, nor within one mile of CSOC. An archaeological survey of the CSOC sites has not been performed to-date although there are no indications based on previous knowledge of the area, that any archaeological finds other than indian arrowheads are likely to be found.

III.A.7 Geology and Soils (AFERN 3.1.2 and 3.1.3)

Section 26 consists primarily of Eolian sands and is traversed by two natural drainage courses. Section 24 is comprised entirely of Eolian sands. The primary characteristic of this soil is its susceptibility to erosion when grading occurs and existing vegetation is removed. With proper drainage control and stabilization of exposed slopes, erosion control can be established and maintained. There are no known areas that cannot adequately support the CSOC structures because of poor soil conditions.

The Master Plan for the Extraction of Commercial Mineral Deposits in El Paso County does not identify any sources of strippable coal, refractory clay, quarry aggregate or gravel closer than 2 miles from Section 24 or 26. However, all of eastern and northeastern El Paso County contains sand and fine aggregate resources.

Geologic hazards including neogene igneous rocks, hot springs and landslides are not present in the vicinity of the CSOC sites. The entire state of Colorado is in Seismic Zone 1 in which minor damage can occur. Although there are no potentially active faults in the area of the CSOC, three quakes have been felt within a 30-mile radius of Sections 24 and 26.

III.A.8 Meteorology (AFERN 3.3.1)

The proposed CSOC is to be located about 10 miles east of the nearest full-time weather observing site at Peterson AFB. The climatic data presented are for Peterson but qualifying remarks are provided to better describe the climate at the CSOC location.

Peterson AFB is located in relatively flat semi-arid county on the eastern slope of the Rocky Mountains; the CSOC sites are about 10 miles further east on a slight plateau. The region, because of its 6,200 foot MSL elevation and its sheltered lee-side position, is subject to large diurnal temperature variations. The average daily maximum temperatures in July and January are 85°F and 45°F; average daily minimums in July and January are 56°F and 17°F, respectively. Extreme temperatures range from 100°F to -27°F. Refer to Table 9 for a climatological data summary of the area.

Monthly average relative humidities vary from a high of 70 percent to a low of 31 percent. The highest humidities are found generally in the early mornings of July and August; lowest humidities usually occur near midday with October being the least humid. The mean number of days per month in which precipitation equals or exceeds .1 inch varies from 3 to 13. Maximum rainfall occurs between May and August. There are 7 days per year on the average when rainfall equals or exceeds .5 inches.

Freezing rain and tornados are rare. Ice accretion on power lines and exposed structures, while statistically rare, will occur slightly more frequently at the CSOC location than at Peterson AFB. Persistent upslope flow of several days duration coupled with freezing temperatures produce freezing fog or drizzle. Ice accretion of 1/4 to 1/2-inch can occur in a matter of hours under these conditions. Numerous downed power lines and poles with subsequent power outages occurred in the winter of 1978-79 near the CSOC site from ice accretion. Fog occurs approximately 48 days per year; dense fog of 1/4 mile or less visibility occurs approximately 21 days per year.

Average annual snowfall is about 38 inches. April has the most snowfall (8.9 inches); maximum 24-hour snowfalls of 18 and 17 inches have been recorded in April and September, respectively. The CSOC location could be expected to have slightly more snow and rain than Peterson AFB. It can be expected that several times a year local roads and highways will be unpassable due to snow. This is particularly the case for county roads more so than for the major highways (such as Highway 94) and arterial roads in Colorado Springs.

TABLE 9

Climatologic Data Summary for Colorado Springs and Plains Area

El Paso County		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
COLORADO SPRINGS Stn. No. 1778	Precipitation (Inches)													
38° 49'N 104° 42'W Elv. 6173'	Total	0.33	0.27	0.69	1.31	2.54	1.85	2.85	2.17	1.18	0.73	0.43	0.17	14.52
(Located in SE Section of City	Total Snowfall	4.8	3.7	7.5	8.9	1.9	T	T	[illegible]	[illegible]	2.1	4.4	2.2	[illegible]
at Peterson Air Force Base)	No. Days ≥ .10"	1	1	3	4	6	4	7	5	3	2	2	1	39
	No. Days ≥ .50"	+	0	+	1	2	1	1	1	1	+	+	0	7
	Temperature: (°F)													
	Extreme High	69	72	73	81	88	100	100	99	94	[illegible]	74	77	[illegible]
	Mean Maximum	44.7	45.4	48.6	58.1	[illegible]	80.8	85.4	83.7	77.1	64.8	50.9	47.0	[illegible]
	Mean	30.7	31.9	35.4	44.5	55.4	66.1	70.9	69.5	62.1	[illegible]	37.0	33.0	[illegible]
	Mean Minimum	16.7	18.3	22.2	31.3	42.6	51.4	56.4	55.3	45.1	[illegible]	23.0	18.9	35.0
	Extreme Low	-26	-27	-11	0	21	32	42	43	26	[illegible]	-8	-4	[illegible]
	No. Days ≥ 90°	0	0	0	0	0	5	9	6	2	0	0	0	22
	No. Days ≥ 32°	30	27	28	16	2	0	0	0	1	[illegible]	26	30	[illegible]
	Degree Day Normals	1128	952	908	597	332	93	16	31	141	456	825	1032	[illegible]
FOUNTAIN 9 NE Stn. No. 3068	Precipitation (Inches)													
38° 47'N 104° 37'W Elev. 5960'	Total	0.27	0.14	0.41	1.26	2.47	1.69	2.29	2.44	0.86	[illegible]	0.41	0.18	[illegible]
(Located approximately 5 miles	No. Days ≥ .10"	1	1	2	3	6	4	6	4	2	[illegible]	1	1	[illegible]
SW of Sections 24 and 26.)	No. Days ≥ .50"	+	0	+	1	2	1	1	[illegible]	1	-	+	+	8
BIG SPRINGS RANCH Stn. No. 0712	Precipitation (Inches)													
38° 52'N 104° 19'W	Total	0.15	0.14	0.34	1.07	2.74	1.12	1.95	2.43	0.78	[illegible]	0.22	[illegible]	[illegible]
(Located 18 miles E. of Sections 24 and 26)														

+ More than 0 but less than 0.5 T - Trace

Source: Weather Bureau, 1964. Climatic Summary of the United States - Supplement for 1951 through 1960, Colorado.

Surface winds are probably lighter at the CSOC location than at Peterson AFB. The CSOC location, however, will probably experience a more persistent wind (and therefore a higher mean wind speed) because of its location on the open plains. The mean annual wind speed at Peterson is about 9 knots, but winds in excess of 45 knots have been recorded every month. Winds of 70 knots or more have been measured in five months with an extreme peak of 78 knots. The Chinook, a warming downslope wind, tends to prevent snow accumulations from remaining long on the ground.

The thunderstorm season runs April through October with the peak months of May through August. Thunderstorm days range from 1 in October to 16 in July at Peterson, but thunderstorms are present nearly everyday somewhere in the general area during the storm season. These storms usually develop along the Rockies and drift eastward. Most storms weaken or dissipate as they move eastward off the mountains toward Peterson and often re-form further east. It is uncertain whether the re-formation occurs in the immediate vicinity of the CSOC or further east. Thunderstorms in this region have a high risk of hail. During the peak hail month (June), Peterson experiences 2-3 days with hail. Hail is reported nearby on 5-6 days during the month of June. The potential for large hail exists in and around the Colorado Springs area; in 1978 golfball-size hail produced some $30 million in damages in Colorado Springs.

The Fountain 9 and Big Springs weather station data in Table 9 are provided merely for supplemental information on climate in the vicinity of CSOC.

III.A.9 Socioeconomic Environment (AFERN 4.1, 4.2, 4.3)

III.A.9.1 Education (AFERN 4.3.3)

The Colorado Springs area is served by 15 school districts; 11 of these districts are considered of relevance to the incoming CSOC population. By far the largest of these districts is No. 11 which operates 38 elementary schools, 10 junior highs and 5 senior highs in the urban area of Colorado Springs. In addition to District 11 there are several other smaller districts operating in the city limits and in communities adjoining Colorado Springs. For purposes of this analysis only District 11 and districts serving the southeast, east, and northeast sections of Colorado Springs will be considered as it is these areas of the city where most of the CSOC population will probably reside.

District 11 which had a peak enrollment of just under 36,000 students in 1972 has been declining ever since. Other districts serving areas of town where growth is occurring are experiencing the reverse trend, but this is only on a very localized basis. In general, student population throughout the state and the nation is declining due to the decreasing birth rate.

Table 10 on the following page summarizes by district and by grade, the present enrollment and estimated capacity. Future projections of student enrollment were not available from these districts.

Major sources of revenue for the districts are local property taxes, State and Federal Average Daily Attendance (ADA) funds. Federal ADA funds are allocated under Public Law 93-380 for children of parents who are employed by a military or federal installation.

Table 10

School District Enrollments and Capacities in Colorado Springs Area

School District	Grade Level	1980 Enrollment	1980 Capacity	1980 Unused Capacity
No. 11 - Colo. Springs	K-6 (38)*	16,892	22,469	5,577
	7-9 (10)	7,164	10,265	3,101
	10-12 (5)	7,670	8,924	1,255
	Total	31,726	41,650	9,93[illegible]
No. 2 - Harrison	K-6 (7)	[illegible],958	At Capacity	0
	7-9 (3)	1,537		
	10-12 (1)	1,335		
	Total	6,830		
[illegible]	K-6 (7)	[illegible],374		
	7-9 (3)	1,658		
	10-12 (1)	1,803		
	Total	6,835	8,000	1,165
No. [illegible] - Fountain	K-6 (4)	2,107		
	7-9 (2)	582		
	10-12 (1)	521		
	Total	3,210	3,400	190
No. 12 - Cheyenne Mountain	K-6 (3)	936	1,000	64
	7-9 (1)	532	600	68
	10-12 (1)	560	600	40
	Total	2,028	2,200	172
No. 14 - Manitou Springs	K-5 (2)	492		
	6-8 (1)	246		
	9-12 (1)	437		
	Total	1,175	1,350	175
No. 20 - Air Academy	K-6 (6)	2,718	At Capacity	(2 Elem. Schools will be ready Fall 81; 1 High School Fall 82)
	7-9 (1)	1,232		
	10-12 (1)	1,277		
	Total	5,227		
No. 22 - Ellicott	K-6	205		
	7-9 (1)	70		
	10-12	135		
	Total	410	475	65
No. 23 - Peyton	K-6	108		
	7-8 (1)	30		
	9-12	73		
	Total	211	250	39
No. 38 - Lewis Palmer	K-3 (1)	320		
	4-8 (1)	518		
	9-12 (1)	434		
	Total	1.272	1,550	278**
No. 49 - Falcon	K-6 (2)	728	At Capacity	(1 new Elem. School and expansion*** of 1 Junior High and 1 Senior High will be accomplished if 80 bond election passes)
	7-8 (1)	222		
	9-12 (1)	420		
	Total	1,370		

*Numbers in parentheses are the number of schools in that grade classification.
**One new high school will be built in Fall 1980.
***Expansion program will accommodate an additional 600 students.

III.A.9.2 Military and Civilian Housing (AFERN 4.2.5)

III.A.9.2.1 Military Housing (AFERN 4.2.5.4)

Peterson AFB has a total of 1,342 quarters for permanently assigned officers and enlisted personnel. There are 490 family units, 40 bachelor units, and 812 enlisted or bachelor airmen units. In addition to these permanent quarters there are units available for temporary housing; these include the visiting officer quarters and temporary lodging quarters which are available for both officers and enlisted personnel. The following is a listing of military quarters on the base by rank, type, and total spaces or units in each category.

Qualifying Personnel	Family Units	BOQ	BAQ	VOQ	TLQ
Officers	106	40	--	40	--
Enlisted	384	--	812	--	--
Officers & Enlisted	---	--	--	--	40

Family Housing

Family units on Peterson are less than 20 years old and in good condition; the newest units were built in 1974. There are both single family and multi-family units ranging from duplexes to 6-plexes. Family units by type and quantity are:

Single Family	116 Units
Duplex	12 Units
4-Plex	200 Units
6-Plex	162 Units
TOTAL UNITS	490 Units

All family quarters are currently occupied; the waiting period for family housing depends on the rank of the personnel applying. Officers have from 1 to 4 months and enlisted personnel have 2 to 7 months. The waiting period also varies with the size of the unit desired. For instance, it usually takes at least 6 months before a 4-bedroom house is available due to their scarcity. The summer season has the longest waiting period due to the seasonal reassignment of military personnel to Peterson AFB.

Not included in the above list is a mobile home facility at the base which contains 37 spaces available to both officers and enlisted personnel, single or married. At the present time 34 spaces are filled with privately-owned mobile homes; the rental rate for a space is $35.11 per month.

In addition to the housing located at Peterson AFB there are 200 family units at the Air Force Academy 20 miles north of the base. These units are presently occupied by 24 officers and 176 enlisted personnel. However, the housing at the Academy is not permanently available to Peterson personnel and for this reason their availability for housing CSOC personnel cannot be guaranteed.

Bachelor Housing

There are 852 bachelor quarters comprised of 40 bachelor officer units and 812 enlisted or airmen quarters. Currently 27 enlisted spaces are available for occupancy; all 40 of the officers quarters are occupied at the present time.

III.A.9.2.2 Civilian Housing (AFERN 4.2.5.1)

Colorado Springs has a wide variety of housing stock both in terms of variety and price/rental ranges. Information was obtained from local newspapers and other real estate publications concerning current housing units for rent and for sale. This information is summarized in Table 11 and while the data does not predict the housing market three to five years from now, it does provide an overall picture of the housing market in Colorado Springs which can be compared to housing availability and prices in other communities throughout the United States.

From the information in Table 11, the average 3-bedroom home selling for about $62,241 would require a monthly payment of slightly over $541 (based on a 30-year conventional loan at 20% down and 12 3/4% interest). A 3-bedroom rental house averages $300 a month rent whereas the 3-bedroom apartments averaged about $340 a month rent. Of the housing units listed, 3-bedroom homes were the most prevalent representing 45% of the for sale units and 51% of the for rent units. The majority of the apartments listed were 2-bedroom units averaging $230 a month rental rate.

The range of selling prices from $29,950 for a 2-bedroom home, to $250,000 for a 5-bedroom home, indicate that a wide selection of price, age and quality exist in the present housing market in Colorado Springs. The rental market has an even wider range of types and rental rates ranging from a 1-bedroom apartment renting for $95 a month to a 5-bedroom house renting for $400 a month.

The Housing Assistance Plan (HAP*) for 1979 reported that the total housing stock in Colorado Springs was 72,030 units. Of this total, 45,027 were owned units and 27,003 were rental units. At a current rental vacancy rate of 7.75% there are an estimated 2,093 vacant units on the market at the present time. The vacancy rate for owned units is 1.59% which means that there are about 716 vacant homes for sale.

The condition of the housing stock in Colorado Springs is discussed in the 1979 HAP. Housing suitable for rehabilitation** amounts to about 15% of the entire stock, or 11,015 units. There are 462 of these units that are designated as substandard. (NOTE: Substandard as defined by the Department of Housing and Urban Development is any structure that is lacking some or all plumbing facilities and/or has two or more major building code violations.) Of the 462 substandard units, 21 of them are not recommended for rehabilitation.

*Provided by the Colorado Springs Community Development Department

**A unit is considered a viable candidate for rehabilitation if the structure has not deteriorated beyond 50% of its market value.

Table 11

Survey of Available Housing in the Colorado Springs Area(1)

Homes for Sale

Bedrooms	Percent Distribution	Average Monthly Payment(2)	Price Range Low	Price Range Average	Price Range High
2	14	$390.14	$29,950	$44,912	$118,000
3	45	541.19	29,950	62,241	193,500
4	32	700.94	39,950	74,423	179,500
5	9	803.09	43,900	92,367	250,000
	100				

Homes for Rent(3)

Bedrooms	Percent Distribution	Average Monthly Rent	Rent Range
1	7	$130	$100 - 150
2	21	290	150 - 415
3	51	300	175 - 400
4	17	325	250 - 395
5	4	350	300 - 400
	100		

Apartments for Rent(3)

Bedrooms	Percent Distribution	Average Monthly Rent	Rent Range
1	29	$170	$ 95 - 253
2	65	230	120 - 390
3	6	340	300 - 375
	100		

(1) Colorado Springs Sun, Sunday, January 20, 1980 and Colorado Springs Area Homes Illustrated, February 16, 1980.

(2) Payment table for monthly mortgage loans based on a 30 year conventional loan, 20% down at 12 3/4% interest, principal and interest only. Source: First American Title Insurance Co.

(3) Unfurnished.

III.A.9.3 Employment/Unemployment Status (AFERN 4.2.2)

In November 1979 the civilian labor force for the region was 124,590 (data obtained from the Colorado Springs Chamber of Commerce); this figure represents an increase of 3% from November 1978. The total number of persons employed in November 1979 was 119,770; the unemployment rate was 3.9%. The average annual unemployment rate for the region (i.e., the Colorado Springs Standard Metropolitan Statistical Area - SMSA, which includes all of El Paso County and adjoining Teller County) was 4.1% compared to the state-wide average of 3.3% and the national average of 6%. During the last few years the unemployment rate in the Colorado Springs SMSA declined from 6.2% in 1976 to 4.1% in 1979. This drop in unemployment rate has undoubtedly been a result of the recent influx of light industry in Colorado Springs.

There are nine major employment categories in the region with the major employment area in the wholesale/retail trades, government and services.

III.A.9.4 Local Economic Factors (AFERN 4.2.6)

The 1979 cost of living index for Colorado Springs is compared in Table 12 with other cities of comparable size in the western United States. This information was obtained from the American Chamber of Commerce Research Association; cost of living indexes are based on a nationwide average of 100.

Table 12

Cost of Living Indexes

Location	All Index Items	Grocery Items	Housing	Utilities	Trans-port'n	Health Care	Misc. Goods & Services
Colorado Springs, Col.	94.5	94.3	101.6	61.3	96.2	96.4	106.0
Denver, Col.	103.1	94.5	120.6	75.7	106.7	106.0	104.6
San Jose, Cal.	110.8	93.8	141.1	64.8	113.2	131.7	110.9
Albuquerque, New Mex.	105.9	104.5	110.0	114.7	104.6	103.3	97.6
Great Falls, Montana	94.9	107.5	80.7	66.3	105.1	95.6	109.7

Colorado Springs has a moderately low cost of living index of 94.5 (the nationwide low is at Shenandoah, Iowa with 82.6; nationwide high is in Palm Springs, California at 125.3); however, this index is expected to increase as new industry requiring a labor force with earnings in the mid to upper income levels locate in Colorado Springs. Historic trends in other American cities indicate that as the income level increases, a higher standard of services and facilities are demanded, which in turn increases the cost of goods and services, housing, etc.

III.B Alternate 1 Location - Kirtland Air Force Base, Albuquerque, New Mexico

III.B.1 General Description of Region

The Alternate 1 location for the CSOC facility is Kirtland Air Force Base in Albuquerque, New Mexico. The base is located adjacent to the southeast city limits and is bounded on the east by the Cibola National Forest and on the south by the Isleta Indian Reservation, as indicated in Figure 6. Kirtland AFB is one of the largest in the United States, containing some 54,000 acres.

Albuquerque sits at a MSL elevation of 5,314 feet; the city spreads north and south along the Rio Grande river basin, and east and west on the mesas bordering the river. The Sandia Mountains are at the eastern edge of the city and they rise to an elevation slightly over 10,600 feet. The city limits now encompass about 85 square miles in the center of Bernalillo County. The 1978 population of Albuquerque was 295,300, representing about 77 percent of the total county population.

Albuquerque is the geographical center of New Mexico and is considered the state's major city for conventions, tourism, transportation (surface, air and rail), and governmental agencies. The area has an extensive health care system which includes 10 hospitals. There are over 300 churches representing every major denomination. As the state's cultural center it contains a wide variety of theaters (including opera, ballet, dance, plays), several large library systems, and many museums and galleries. Recreational activities are provided in the over 125 developed city parks, as well as in a number of other local recreational sports centers. Albuquerque is the home of the New Mexico State Fair which is ranked number one in the United States in attendance. There are large lakes for boating, fishing and water skiing located within a 200-mile radius. The State Fish and Game Department stocks the irrigation and drainage ditches in the city and nearby suburbs with trout, thus providing year-round fishing for the residents. Hunting is a favorite pastime in the mountains east of Albuquerque where deer, elk, bighorn sheep and other game varieties are abundant.

III.B.2 General Description of CSOC Location at Kirtland AFB

The configuration selected for the CSOC facility is presented in Figure 7. The facility would be located in the Kirtland East section of the base in the vicinity of the Manzano Area. In keeping with the desired criteria for this project, six of the existing Manzano buildings would be restored and used for CSOC support activities. The three-story Technical Building and a powerplant structure would have to be constructed on the west side of Vandenberg Road; other buildings identified for restoration are indicated in Figure 8.

The antenna field shown in Figure 7 would be remotely located about two miles southeast of the Manzano Area, between Coyote Springs Road and Demolition Range Road. A data communications link between the antenna field and the Technical Building would be maintained via a fiber-optics or coax cable installed underground and encased in concrete.

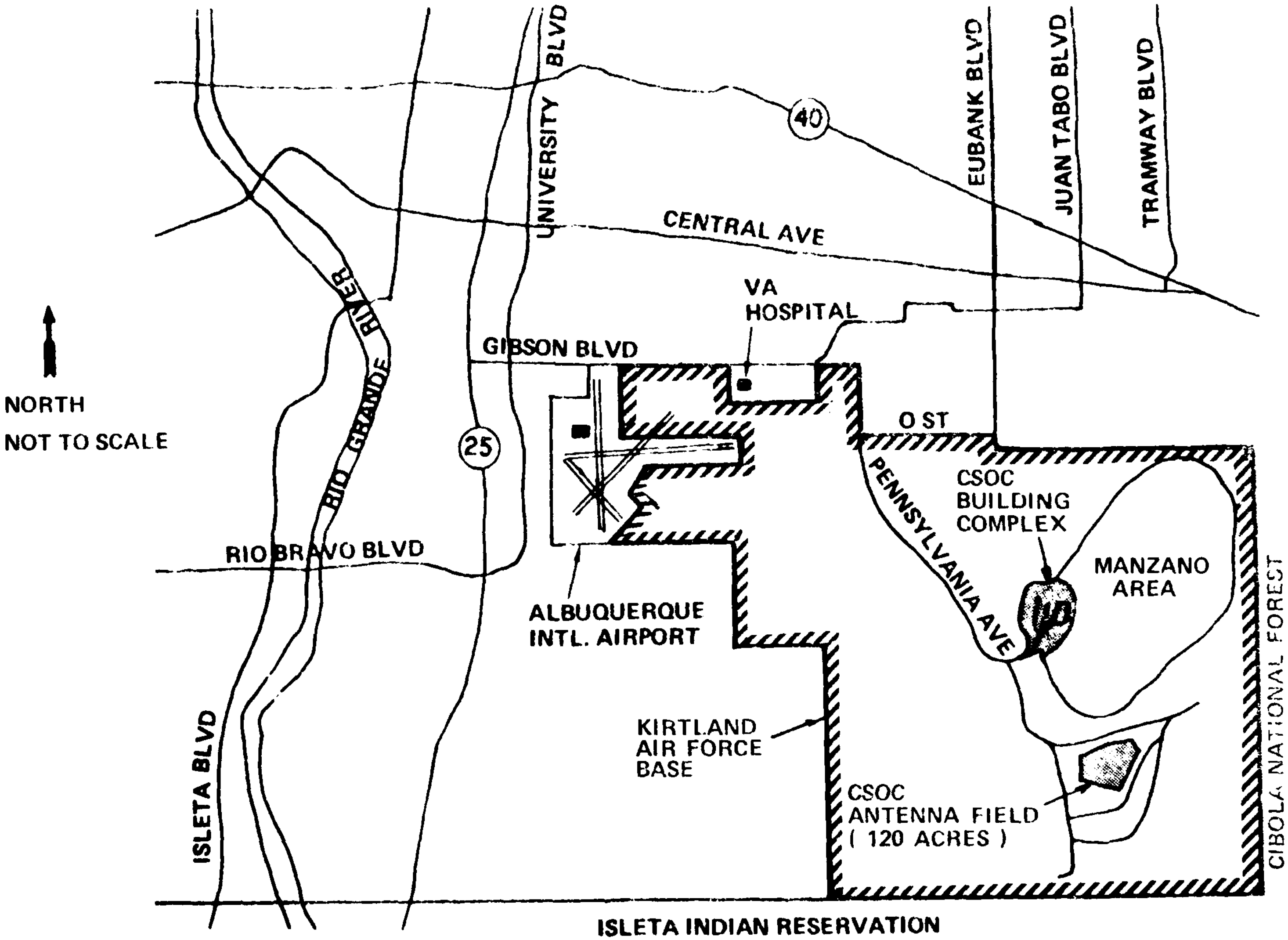


Figure 6 Location of Alternate 1 Sites at Kirtland Air Force Base

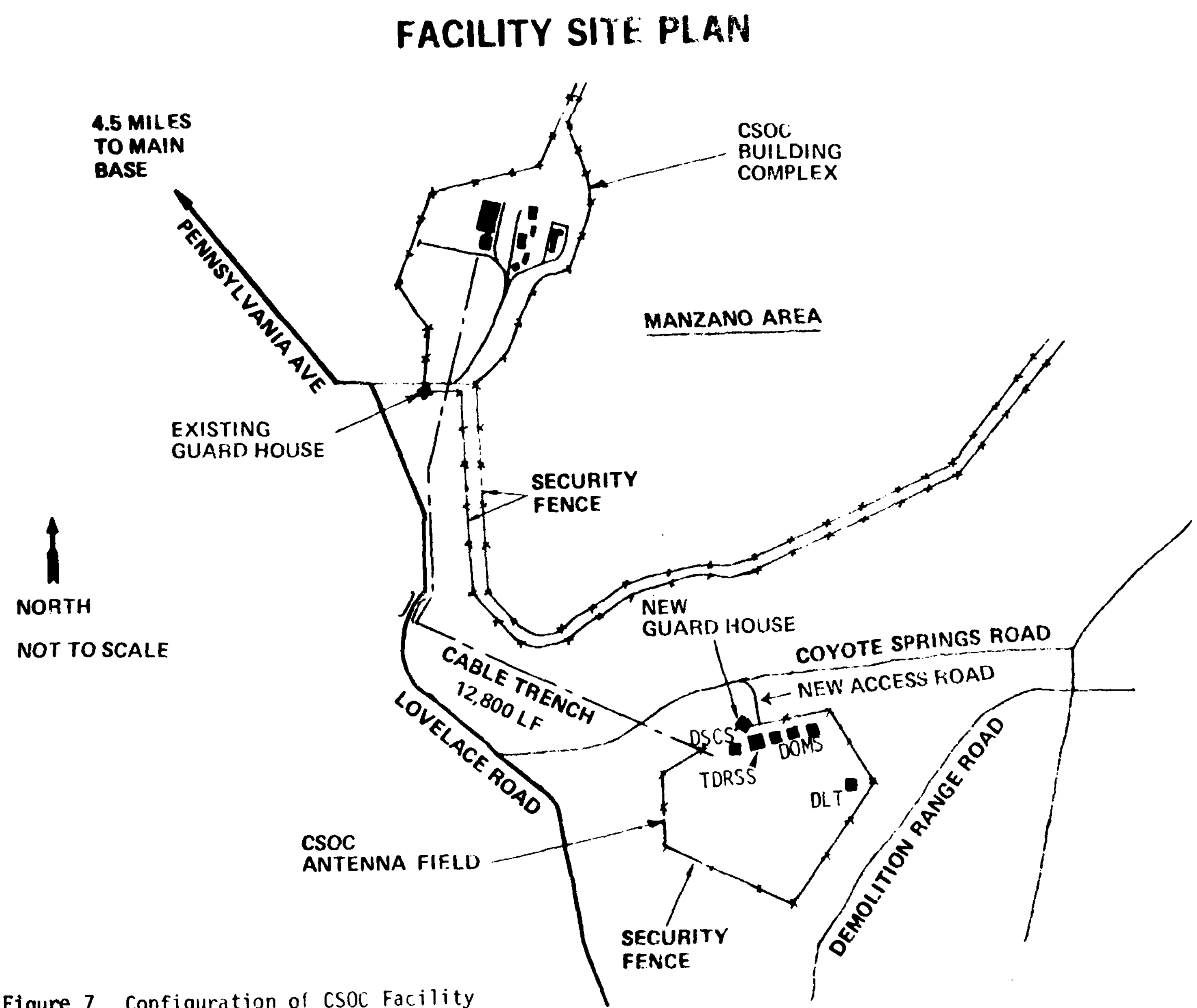


Figure 7 Configuration of CSOC Facility at Kirtland Air Force Base

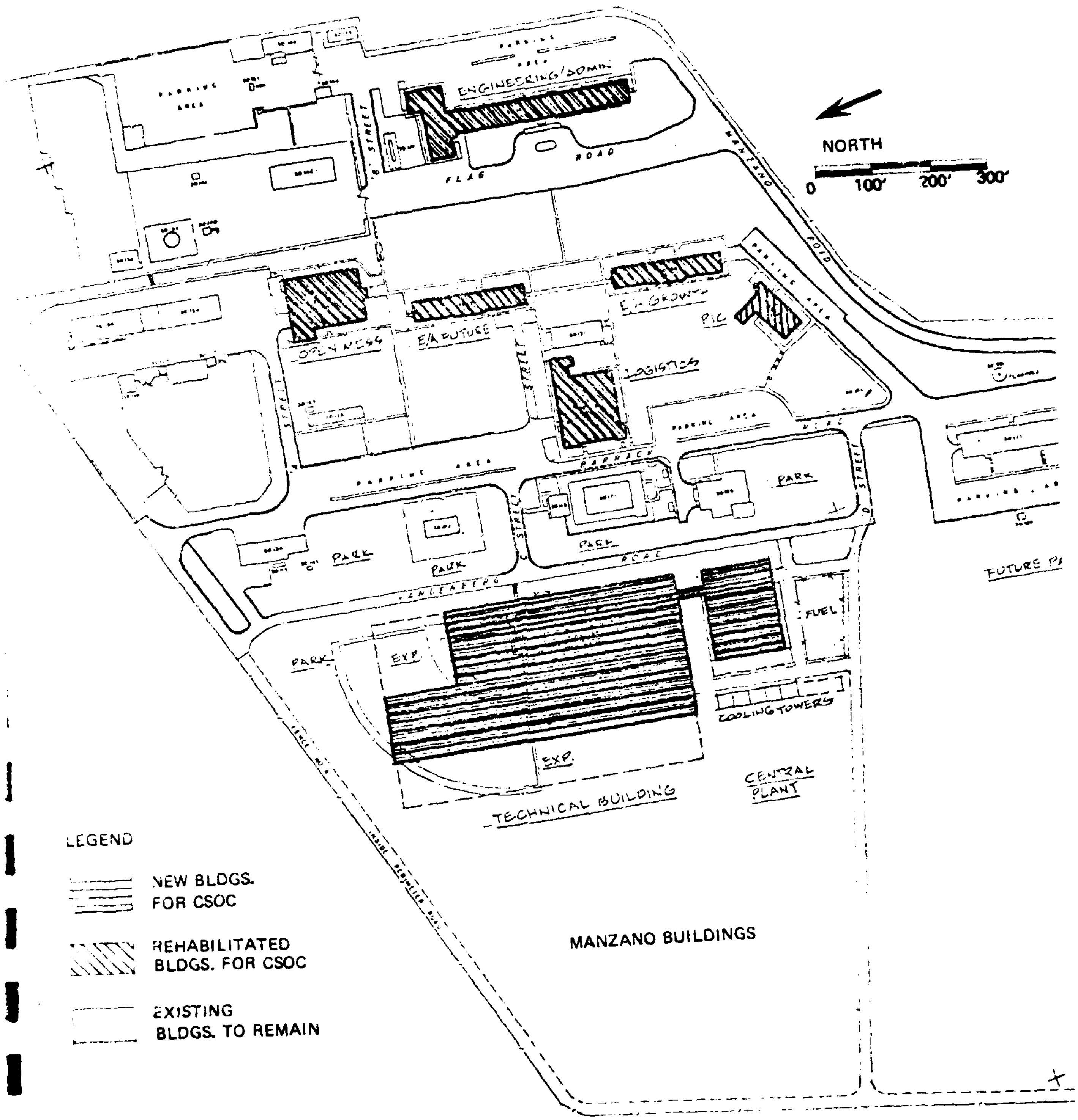


Figure 8 CSOC Building Complex at Manzano Area

The Manzano Area is a highly secure installation with more than adequate existing fencing and perimeter patrol roads for meeting the security requirements of the CSOC Building Complex. The remote antenna field will require, however, installation of security fencing, construction of a perimeter patrol road and guardhouse.

The existing Guard Dog Training Facility presently located in the Manzano Area on the west side of Vandenberg Road will have to be relocated elsewhere to make room for the Technical Building. Since the Manzano Area includes a fully-equipped operational Fire Station it will not be necessary to construct a new station for the CSOC.

III.B.3 Existing Traffic Environment (AFERN 4.4.1.2)

Several entry gates and interior base roads will be impacted by the additional vehicular traffic generated by the CSOC facility. Pennsylvania Avenue connects the Manzano Area to the main part of the base where the traffic is then dispersed during peak periods to various entry/exit gates. Traffic on Pennsylvania Avenue in the vicinity of the Manzano Area is minimal; however, Pennsylvania Avenue is the convoy route leading to the munitions storage area at Manzano and is therefore subject to periodic traffic disruptions. Off-road parking areas are provided at intervals for vehicles that are required to vacate Pennsylvania Avenue during a convoy maneuver.

Traffic to and from the CSOC facility will for the most part, utilize the Wyoming and Gibson gates where March 1979 traffic counts indicated a total of 21,800 and 20,600 vehicles per day, respectively. Traffic problems on the base are generally confined to the peak hours where the major streets (Gibson, Wyoming and Pennsylvania Avenue north of 'O' Street) become congested. The base has already implemented "flex-time" (staggered work hours) and one-way street systems in certain areas of the base to minimize peak hour congestion.

Traffic rapidly diffuses throughout major streets and highways in the Albuquerque area once it leaves the base. Gibson Boulevard was recently widened (completed in 1978) from Carlisle west to Yale Avenue. The 1978 traffic flows for off-base roads in the vicinity of the base are indicated in Figure 9.

The Albuquerque area is served by two major interstate highways, I-40 and I-25. The city's arterial system is maintained in excellent condition and is tied to I-25 and I-40. These two highways intersect in the downtown area as shown in Figure 10, and provide access to all major streets. Local transportation is dependent primarily on surface systems with the automobile being the dominant mode. Albuquerque operates a public bus system which provides service throughout the city. Local governmental agencies and commissions have studied two potential transportation corridors that would serve the southeastern part of the city. This study concluded that the "Gibson East Corridor", as shown on Figure 10, is the most desirable route. They further concluded that the "Future Tijeras Arroyo Corridor" which was to be located south of the Gibson East Corridor, should be eliminated from further consideration because of interference with Department of Defense activities on the base. The Gibson East Corridor route is being determined by a joint effort involving the base and local and state government. When constructed this arterial will greatly improve on-base congestion and relieve traffic volumes generated by base traffic on public roads. Construction of the corridor is 5-10 years in the future.

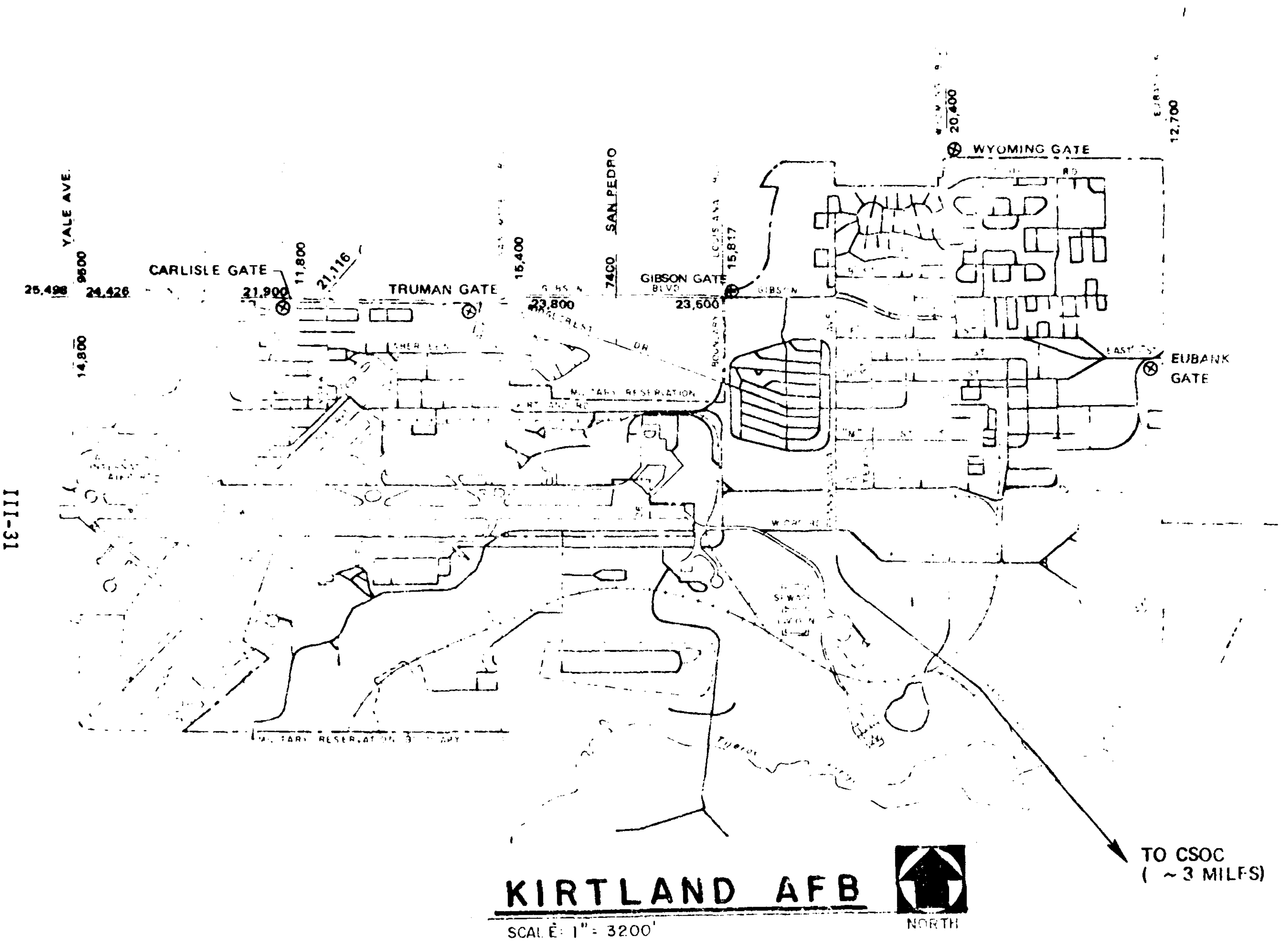


Figure 9 1978 Average Daily Traffic on Albuquerque Roads in Vicinity of Kirtland AFB

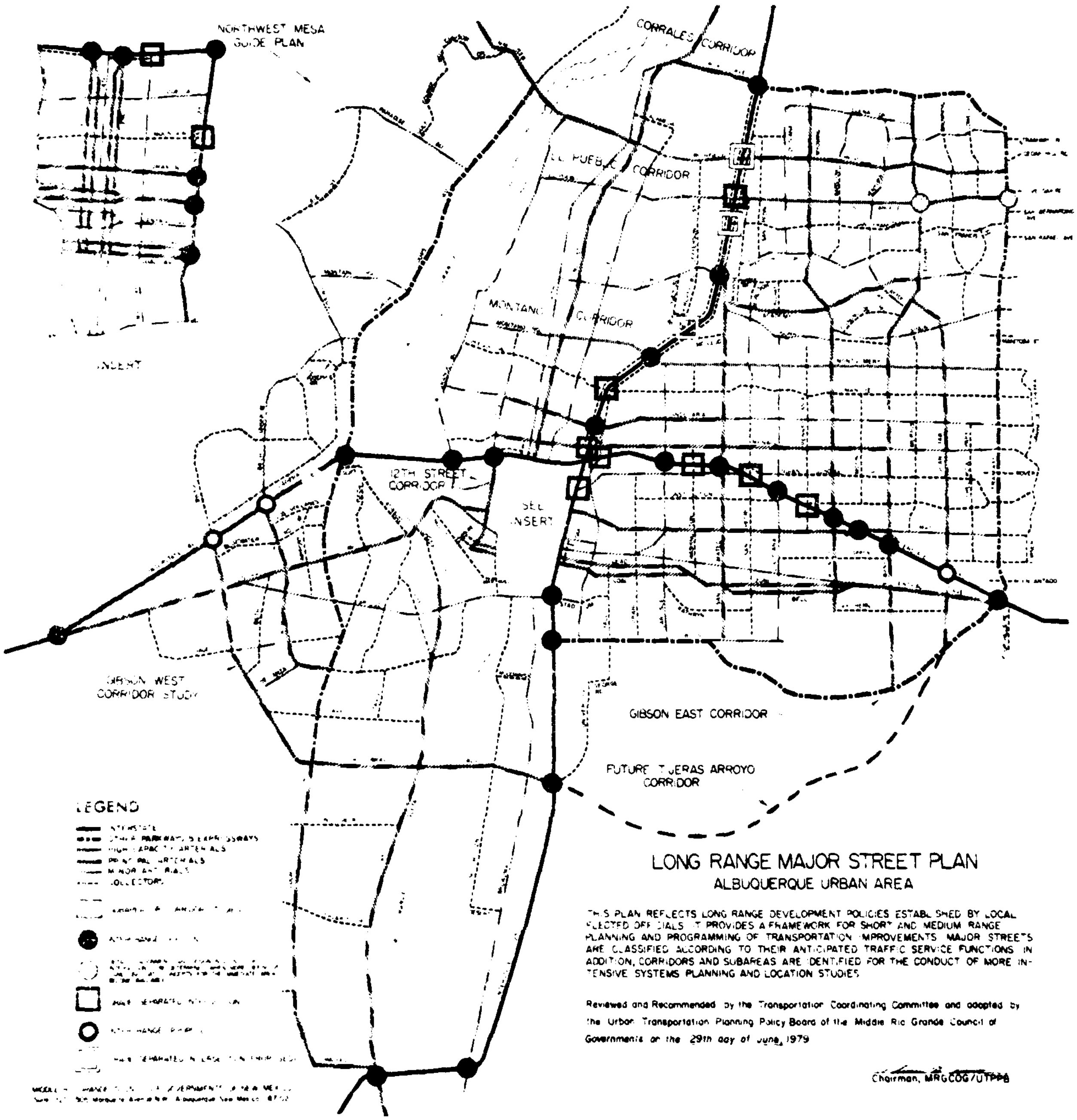


Figure 10 Long-Range Major Street Plan for the Albuquerque Area

III.B.4 Existing Air Quality Environment (AFERN 3.3)

Albuquerque experiences some air pollution problems, which have worsened in recent years due to population growth and an accompanying increase in motor vehicle traffic. Air quality is further aggravated by certain natural conditions in the Albuquerque area such as the low-lying valley bordering the river which tends to trap and concentrate pollutants, frequent low-level temperature inversions especially in winter which also tend to trap pollutants, and infrequent rainfall to cleanse the air.

State and Federal Ambient Air Quality Standards are presented in Table 13. The Albuquerque Air Quality Control Region has been designated a non-attainment area for carbon monoxide, photochemical oxidants, and total suspended particulates. Of the three, carbon monoxide is the most significant air quality problem and is directly related to the increase in motor vehicle traffic. In fact, the worst violation problems occur in areas of high traffic density such as the major shopping centers and in downtown Albuquerque. The natural background level of ozone in the area is generally about .05 ppm. However, violations of the Federal standards are common, particularly in summer when abundant sunlight is available to produce elevated ozone concentrations via photochemical reactions between nitrogen oxides and hydrocarbon pollutants. These ozone precursor pollutants are directly related to motor vehicle traffic. The control strategies used are the same as those employed to reduce nitrogen oxide, hydrocarbon and carbon monoxide emissions. These include improvement of vehicle exhaust controls, less reliance on cars for travel, and improved traffic flows; vehicle inspections and retrofit of pollution control devices are also being considered. Total suspended particulate air quality standard violations are the most frequent in spring time and are associated primarily with natural dust storms and airborne dust from unpaved roads. The control strategy for particulates includes paving existing dirt roads and restrictions on open burning and grading operations. Monitoring of the ambient air is a major portion of the total control strategy program. Eleven sites are monitored for total suspended particulates; two sites for sulfur dioxide; eight for nitrogen oxide; four for carbon monoxide; two for oxides. The engineering section of the Air Pollution Control Division handles review of new source and development regulation. Building construction plans must demonstrate dust control measures during the construction phase of projects which involve more than 3/4 of an acre.

The 1977 and 1978 emissions inventories for Albuquerque and Bernalillo County are summarized in Table 14. It is apparent from this data that transportation sources are the major cause of carbon monoxide, ozones (resulting from hydrocarbon emissions), and nitrogen dioxide, as well as being the major cause of the total emissions in all categories. The transportation category includes both surface and air traffic plus fuel storage and marketing emissions. Of the total 347,928 tons emitted in 1978 from all transportation-related sources, 98.5% are automobile-related. Compared to the total pollutants emitted in all source categories, the automobile is responsible for 93% of the emissions. The upward trend in hydrocarbons has caused the city to require vapor recovery systems at gas stations and gasoline tank farms located in the region.

A comparison of the number of violations occurring in 1977 and 1978 for the three pollutants for which Albuquerque is designated as a non-attainment area, is presented in Table 15. There are no monitoring stations

Table 13

State and Federal Ambient Air Quality Standards
for
New Mexico

Pollutant	Federal Primary Standard	Federal Secondary Standard	State Standard	Albuquerque-Bernalillo Adopted Standards
Total Suspended Particulates				
24-Hour Average	260 $\mu g/m^3$	150 $\mu g/m^3$	150 $\mu g/m^3$	150 $\mu g/m^3$
Annual Geometric Mean	75 $\mu g/m^3$	60 $\mu g/m^3$	60 $\mu g/m^3$	60 $\mu g/m^3$
Sulfur Dioxide				
24-Hour Average	.14 ppm	--	.10 ppm	.032 ppm
Annual Arithmetic Average	.07 ppm	--	.02 ppm	.004 ppm
3-Hour Average	--	.50 ppm	--	--
Carbon Monoxide				
8-Hour Average	9 ppm	9 ppm	8.7 ppm	--
1-Hour Average	35 ppm	35 ppm	13.1 ppm	13 ppm
Photochemical Oxidants (Ozones)				
1-Hour Average	.12 ppm	.12 ppm	.06 ppm	.01 ppm
Nitrogen Dioxide				
24-Hour Average	--	--	.10 ppm	--
Annual Arithmetic Average	.05 ppm	.05 ppm	.05 ppm	--

Table 14

1977 and 1978 Emissions inventory
in
Albuquerque Air Quality Control Region

Source	CO *		HC		NO_x		TSP		SO_x	
	1977	1978	1977	1978	1977	1978	1977	1978	1977	1978
Transportation	330,179	305,855	33,585	31,002	8,579	8,883	1,298	1,513	915	675
Stationary Fuel Combustion	9,081	3,294	468	1,831	4,807	5,626	1,687	2,224	284	1,268
Industrial Operations	1,377	22	664	1,342	1,464	--	3,043	2,155	--	--
Refuse Disposal	99	99	36	36	7	7	19	19	1	1
Unpaved Roads	--	--	--	--	--	--	6,439	4,076	--	--
Totals	340,736	309,270	34,753	34,211	14,856	14,516	12,486	9,987	1,200	1,944

*All emissions are in tons per year
Source: Albuquerque Air Pollution Control Division

	1978 Total Emittants	1978 Percent of Total
Transportation	347,928	94.0
Stationary Fuel Combustion	14,243	3.9
Industrial Operations	3,519	1.0
Refuse Disposal	162	~0
Unpaved Roads	4,076	1.1
Total	369,928	100.0%

on-base at Kirtland AFB; however, Air Pollution Emission reports on file with the Environmental Protection Agency show the base to be classified as a minor emitter with all facilities currently in compliance with the Clean Air Act.

Table 15

1977 and 1978 Ambient Air Quality Violations in Albuquerque

Pollutant	Federal Primary Standard	Number of Days Violated 1977	Number of Days Violated 1978
Carbon Monoxide			
8-Hour Average	9 ppm	57	15
1-Hour Average	35 ppm	1	3
Total Suspended Particulates			
24-Hour Average	260 $\mu g/m^3$	15	1
Photochemical Oxidants (Ozone)			
1-Hour Average	.12 ppm	31*	236*

Source: Albuquerque Air Pollution Control Division and State of New Mexico, Air Quality Section of Health and Environment Department.

*Violations of the old standard of .08 ppm

III.B.5 Utilities (AFERN 4.4.2.1 and 4.4.2.2)

There will be a demand for utilities at the CSOC Building Complex (located at the Manzano Area on Kirtland AFB) and to a lesser degree, at the antenna field southeast of the Manzano Area. In addition, the CSOC personnel and their families will generate additional demands for utilities at their homes. Both on-base utilities and regional utility supplies will be examined. For purposes of this analysis it will be assumed that all of the CSOC employees will be new to the Albuquerque area. This represents the maximum potential demand for utilities.

III.B.5.1 Water Resources (AFERN 4.4.2.1 and 4.4.2.2.1)

Albuquerque's water supply is pumped from the massive underground Rio Grande Basin (estimated to contain 2.8 billion acre-feet of water) and stored in enclosed reservoirs prior to distribution to consumers in the area. The system components for pumping, chlorination and fluoridation, storage and distribution are completely automated. Albuquerque presently owns water resources amounting to 65,000 acre-feet per year; this is adequate to meet the needs of 730,000 population projected for the year 2020. The city has at the current time, a developed water supply sufficient to accommodate a population of about 540,000 persons.

The east part of Kirtland AFB where the Manzano Area is located, produces most of its water from wells located on-base; this water is chlorinated and treated with metaphosphate prior to distribution. Additional water is purchased from the city since the base is limited by court order to a pumped water allocation of 6,398 acre-feet per year. The Manzano Area system capacity is 700 gallons per minute; the Kirtland East high pressure distribution system which has a capacity to deliver 6,450 gallons per minute, is the source of water for the Manzano Area. There are four reservoirs at Manzano with a total storage capacity of 314,000 gallons.

III.B.5.2 Wastewater Treatment Facilities (AFERN 4.4.2.1 and 4.4.2.2.2)

Albuquerque operates two central treatment plants for treating wastewater. Each facility uses filters to provide initial treatment. Wastewater from Plant #1 is then pumped to the activated-sludge units at Plant #2 where it undergoes primary and secondary clarification, digestion, and filtration before being discharged to the Rio Grande River. Digested sludge is used as a soil conditioner at numerous city parks and sludge gas is burned to generate electricity. The present treatment capacity of these two plants is 47 mgd, which is sufficient to accommodate a population of about 400,000.

Outside the city limits there are in excess of 15,000 on-site sewage treatment systems consisting of cesspools and septic tanks. The total discharge of these systems is estimated to be of the order of 6 mgd and this discharge contributes to the widespread degradation of the groundwater in the shallow aquifer beneath the Rio Grande floodplain. New requirements for these individual systems require use of advanced aerated or evapotranspiration units at sites considered unsuitable for conventional septic tanks and drainfield systems.

The city is also proposing to construct 105 miles of new interceptor and collector sewer lines by 1995 to serve various areas of the city and developing county areas on the outskirts of Albuquerque. Activated sludge facilities at Plant #2 are proposed to be expanded to 59 mgd capacity by 1983 and to 76 mgd by 1990. During the next 20 years, Albuquerque will evaluate the cost-effectiveness of constructing sewers in rural areas which are urbanizing, and determine the feasibility of centralized management of on-site systems.

At Kirtland AFB approximately 80 percent of the base sanitary sewage flows to Albuquerque's central treatment plants. Sewage from the Manzano buildings is collected through a gravity-flow system and carried to the Imhoff Treatment Plant located outside the Manzano secure area and just to the west of the Manzano buildings. This plant has a treatment capacity sufficient for 1500 persons and utilizes an 11,800-gallon reinforced concrete settling basin, a 1740-square foot two-compartment sludge drying bed, and a series of four oxidation ponds. All sewage systems on-base are in compliance with National Pollution Discharge Elimination System Requirements imposed by the Environmental Protection Agency.

III.B.5.3 Natural Gas Supply (AFERN 4.4.2.1 and 4.4.2.2.6)

A natural gas pipeline system from the Four Corners area in northwest New Mexico delivers low-sulfur heating and industrial gas to the Albuquerque area. The Gas Company of New Mexico sells the gas at rates estab-

lished by the Public Services Commission of New Mexico. The latest study of reserves allocated to New Mexico indicated a supply sufficient for Albuquerque's needs for the next 20 years. New construction, however, is seeing an increase in the use of solar heating in place of natural gas for climate control and hot water heating.

A 14-inch high pressure gas main delivers natural gas to Kirtland AFB where it is metered, reduced and distributed on the base for heating purposes. To-date, the natural gas supply has been reliable. There is no natural gas piped to the Manzano Area which uses instead diesel fuel oil and propane for heating.

III.B.5.4 Electrical Power Supply (AFERN 4.4.2.1 and 4.4.2.2.3)

The Public Service Company of New Mexico provides a generating capacity of 334,000 KW to the Albuquerque area, transmitted from the Four Corners area of the state where several coal-fired plants are operating. New Mexico is the third largest exporter of electricity in the United States and is considered an energy-rich state with its abundance of raw material for producing electricity.

Kirtland AFB purchases its power directly from the Public Service Company; the on-base distribution system is comprised of both overhead and underground circuits. Power is supplied to the Manzano Area but not to the area identified for the CSOC antenna field.

III.B.6 Archaeological/Historical Resources (AFERN 4.4.3.7.3)

The Center for Anthropological Studies (a nonprofit research foundation) has recently completed an archaeological/historical site survey in the area where the CSOC antenna field is proposed to be located. Four sites of historic value were identified and are shown on Figure 11. Two of these sites are on the north side of Coyote Springs Road in a small arroyo. Site #10 extends for some distance paralleling Lovelace Road and Coyote Springs Road; it is the route of the old stagecoach road that probably led to the mines in the Sandia and Manzano Mountains to the east. Site #4 is located on the south side of Coyote Springs Road on the brow of a small hill. Several surface artifacts were found at this latter site and it is probable that additional remains could be found buried in the top 8-12 inches of soil. In view of this probability, Site #4 could be impacted by grading/construction activities for the CSOC antenna field. The other three sites will not be deleteriously affected by CSOC construction or operation.

The only other area of concern is in the vicinity of the existing softball field at the Manzano Area (the proposed site of the Technical Building - refer to Figure 8). Minimal grading would be required on this property but the existence of other sites in the area indicates a higher than average probability of finding historical sites in this area.

III.B.7 Geology and Soils (AFERN 3.1.2 and 3.1.3)

The Manzano, Manzanita and Sandia Mountains are composed mainly of Precambrian granitic rocks which crop out along the steep western escarpment. Much of the western slopes of these mountains are covered by a pedi-

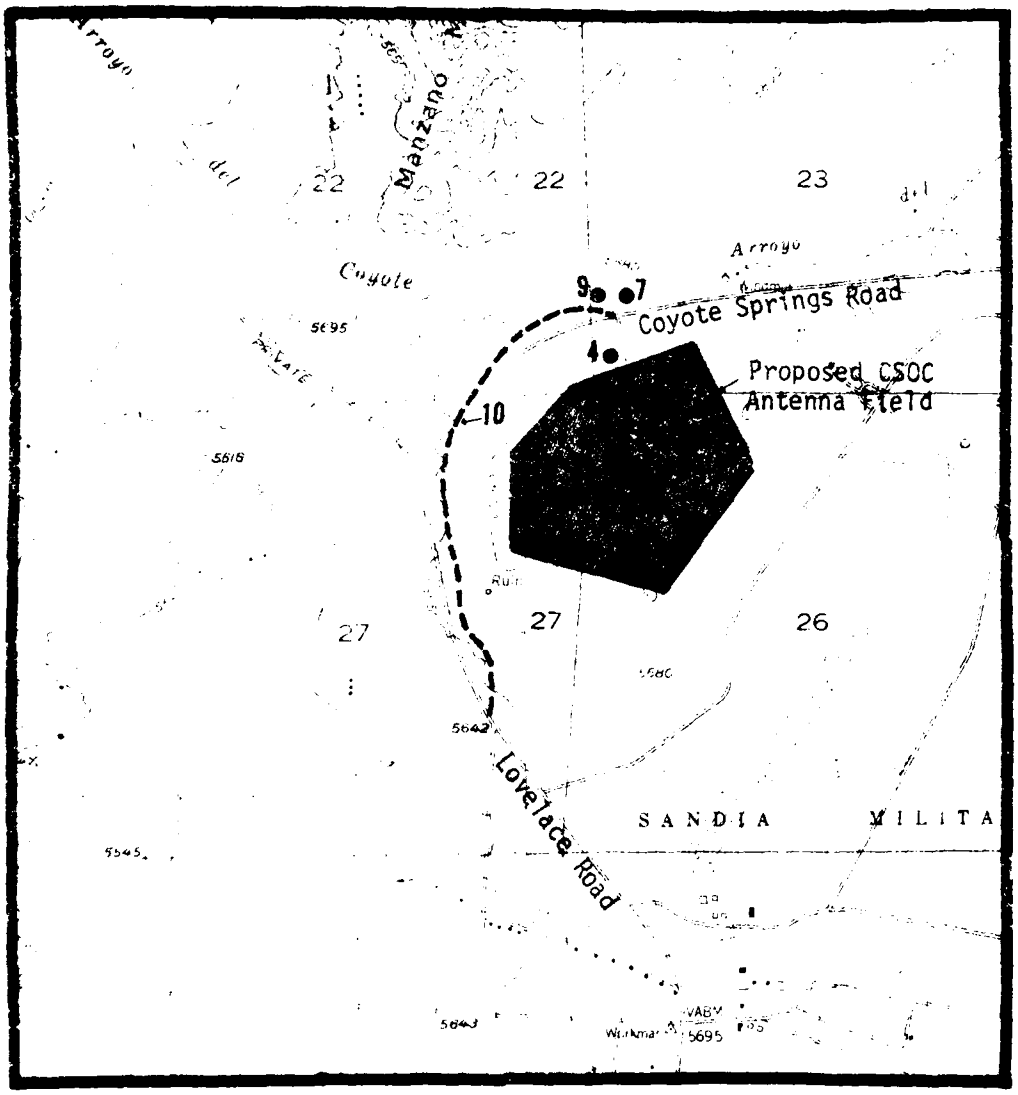


Figure 11 Historical Sites in Vicinity of CSOC Antenna Field at Kirtland AFB

ment of sand and gravel derived from the mountain masses. In the vicinity of the proposed antenna field, the surface soils are of the light gray to light brown Loamy Sand type, possessing moderate to rapid permeability, fair to good compaction, good bearing capacity, and low shrink-swell tendencies. These characteristics are favorable for supporting structures such as buildings and antennas. On the other hand, Loamy Sand soils may have a moderate to high susceptibility to erosion which must be controlled by adequate vegetative groundcover and surface drainage. A band of caliche lies 12 to 24 inches below the surface and can vary in thickness from one to four feet or more. Plant materials that are resistant to chlorosis should be used along with ground manure or peat where the caliche layer is near the surface.

The topography of the antenna field site consists of randomly placed rolling knolls and minor gullies; elevation ranges from 5,814 feet (the highest knoll near the center of the site) to 5,640 feet MSL along Lovelace Road.

Small earthquakes are not uncommon in the Albuquerque area where they occur up and down the Rio Grande Valley, especially south towards Socorro. Although there are no identifiable faults in the Manzano Area, the entire Albuquerque Area, including the base, is located in Seismic Zone 2 (zone of moderate damage).

III.B.8 Meteorology (AFERN 3.3.1)

The climate of the Albuquerque area is characteristic of high-altitude, dry continental climates having low annual rainfall, wide extremes of temperature, scattered thunderstorms in summer, and low relative humidity. There is a large number of clear days and a high percentage of sunshine; in both summer and winter sunshine is recorded during more than 75 percent of the daylight hours. Solar radiation is therefore used as an alternate energy source.

The average daily maximum temperatures in July and January are 92°F and 47°F; average daily minimums in July and January are 65°F and 23°F respectively. Extreme temperatures are 105°F and -17°F. Temperatures of over 100°F and under 0°F are fairly rare, occurring only on the average of once or twice every 4-5 years.

Monthly average relative humidities vary from a high of 55 percent to a low of 29 percent. The highest humidities are found generally in early mornings of December and January; lowest humidities usually occur near mid-day with June being the least humid month. The mean number of days per month in which precipitation equals or exceeds .01 inch varies from a high of 9 days each in July and August to 3-5 days for the other months. Rainfall rates of greater than .5 inch per hour occur on the average once a year, usually during July or August thunderstorms. Mean annual precipitation for Albuquerque is only 7.39 inches. Most precipitation in the area occurs during localized thunderstorms, which sometimes are torrential and can cause flash flooding in normally dry washes.

Freezing rain, although rare, does occur particularly from late December through January. Severe thunderstorms and tornados are also rare. Average annual snowfall is only about 9-10 inches per year and snow seldom lasts on the ground beyond a day. Hail of 1/4 inch diameter or less can be expected four or five times per year; large hail is rare.

The mean annual wind speed for Albuquerque is slightly less than 8 knots, but winds in excess of 50 knots have been recorded in every month with a maximum of 78 knots. Dust storms occur on the average about twice a year. The average number of hours with visibility restricted by dust amounts to about 54 per year. The thunderstorm season runs from March through November with an average of 1-5 storms per month, except in July and August which average 12 per month. During the thunderstorm season, thunderstorms are present nearly everyday somewhere in the general area.

Meteorological data is presented in Table 16; this data is valid for the Albuquerque area and represents data obtained from 1942-1967.

III.8.9 Socioeconomic Environment (AFERN 4.1, 4.2, 4.3)

III.8.9.1 Education (AFERN 4.3.3)

The Albuquerque Public School District includes virtually all of Bernalillo County. It is the 27th largest district by population in the United States and currently has 74 elementary schools, 22 junior high and middle schools, and 10 high schools. Enrollment in the district peaked in 1973 at just under 86,000 students; this has since declined to the present enrollment of 72,270 students. Student population is projected to decrease even further over the next five-year period and then begin an upswing in the mid-to-late 1980s. Table 17 lists the district's enrollment history and the projections through 1985.

Table 17

Historical and Projected Student Population for Albuquerque Public Schools

Grade Level	1971	1973	1975	1980	1983	1985
K-6	44,006	43,246	39,524	38,040	37,165	36,725
7-9	20,907	22,211	22,660	18,158	16,929	16,743
10-12	18,137	20,337	20,661	21,072	17,977	16,841
Total	83,050	85,974*	82,845	77,270**	72,071	70,309

*Peak Enrollment **Present Enrollment

The steady decline since 1973 has resulted in the closure of 12 elementary schools, one junior high and one senior high. Schools in northwest and southwest Albuquerque, however, have not been able to keep pace with the rapid expansion of housing and some students are being transported to schools in the downtown area which have extra space. A bond issue will soon be acted on by the voters which if passed, will be used to build new schools. The district also has over 650 portable classrooms which are used as needed for alleviating crowded classrooms.

Table 16

Climatological Data Summary for Albuquerque*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
Mean Monthly Precipitation (inches)	.28	.39	.41	.47	.46	.49	1.30	1.30	.74	.73	.30	.52	7.39
Mean Monthly Snowfall (inches)	1.8	1.7	1.6	Trace	Trace	0	0	0	Trace	Trace	1.1	3.0	9.20
Temperature (°F)													
Extreme Maximum	69	72	85	89	98	102	105	100	98	87	74	72	105
Mean Maximum	47.1	52.3	59.3	70.0	79.7	89.2	91.8	89.1	83.1	71.3	57.1	47.5	69.8
Mean	35.3	40.0	45.9	55.8	65.3	74.5	78.7	76.4	70.1	58.2	44.8	36.4	56.8
Mean Minimum	23.3	27.3	32.2	41.3	50.5	59.6	65.3	63.4	56.8	44.8	32.2	25.0	43.5
Exreme Minimum	-17	-5	8	19	28	42	55	52	37	25	10	3	-17
Wind													
Prevailing Direction	N	E	E	E	E	E	E	E	E	E	E	E	E
Mean Speed (knots)	6.7	7.6	8.7	9.4	8.9	8.3	7.7	6.8	7.3	7.1	6.6	6.3	7.7
Mean Relative Humidity (Percent)	54.4	48.9	40.0	33.0	30.6	28.6	41.7	47.4	41.8	43.7	48.5	55.1	42.8

*Period of Record 1942-1967

Source: U.S.A.F. ETAC (Environmental Technical Applications Center), Scott AFB, Illinois.

Albuquerque also has a substantial number of private and parochial schools providing instruction at all grade levels. Higher educational institutions include the University of Albuquerque (private-1400 students) and the University of New Mexico (public-23,000 enrollment). This university is the largest publicly-supported institute in the state. General college courses are offered on base through the University of Albuquerque; Master's programs are offered by the New Mexico Highlands University and Webster College.

III.B.9.2 Military and Civilian Housing (AFERN 4.2.5)

III.B.9.2.1 Military Housing (AFERN 4.2.5.4)

Kirtland AFB has a total of 4,261 quarters for permanently assigned officers and enlisted personnel. There are 2,134 family units, 48 bachelor officers quarters and 2,077 enlisted or bachelor airmen units. In addition to these permanent quarters there are units available for temporary housing for both officers and enlisted personnel; these units include 580 transient quarters and 58 guest houses. The following is a listing of military quarters on the base by rank, type and total spaces (or units) in each category.

Qualifying Personnel	Family Units	BOQ	BAQ	Transient	Guest Houses
Officers	379	48	---	211	--
Enlisted	1755	--	2077*	369	--
Officer and Enlisted	---	--	---	---	58

Family Housing

Family units on Kirtland are 21 to 37 years old and in good condition. At the present time, there are 379 units for officers and 1,755 for enlisted personnel. The waiting period for officer family quarters is 1-30 days, for enlisted E-4 with more than 2 years in grade, 1-60 days; for E-4 less than 2 years in grade and below, when space is available. As of 1 February 1980, there were 400 ineligibles (i.e., enlisted ranks that are normally ineligible for family housing) residing in family quarters.

For all family housing, approximately 80 units are vacant at any one time. These units are in a transition phase due to change of occupancy or renovation.

No new family units are proposed in the near future; however, a mobile home facility is proposed for the western portion of the base. The facility would have mobile home spaces available for privately-owned mobile homes.

The highest turnover rate in family housing is during the summer months when a substantial number of military personnel are assigned to the base. It is not unusual to see almost all of the enlisted and over half the officers seek housing in Albuquerque and surrounding communities due to the shortage of on-base housing. Kirtland also has temporary lodging arrangements with selected motels and apartment complexes near the base to help absorb this demand.

*Of the 2077 BAQ, 3 dorms with 259 spaces at Manzano Area are closed.

Bachelor Housing

There are 2,125 bachelor quarters or spaces at Kirtland: 48 officer and 2,077 enlisted. Most enlisted quarters are 2-person dormitory type rooms with the exception of enlisted E-7 to E-9 which have one person per room. Of the 2,077 enlisted quarters, 150 are allocated for enlisted women. As of 1 February 1980, all 48 BOQs and 1,164 BAQs were occupied. At the Manzano Area, 259 enlisted BAQ spaces are closed, but these could be reactivated if necessary.

III.B.9.2.2 Civilian Housing (AFERN 4.2.5.1)

Albuquerque has a large and varied housing stock offering a wide selection of housing types and price ranges. Information obtained from local publications that list housing units for rent and for sale is summarized in Table 18. From this information it appears that a prospective home buyer can expect to find housing prices ranging from a low of $26,000 for an older 2-bedroom home to a high of $168,500 for a new 4-bedroom home. The most numerous types of housing in the survey were 3-bedroom homes representing 57% of the total number of units for sale listed in the publications cited. The average 3-bedroom home sells for $66,414 with an estimated monthly payment of $566.

In the rental market the average 3-bedroom house for rent has a monthly rental rate of $362; rents range from $250 to $650 per month. The average 2-bedroom apartment rents for about $230 a month; apartment rents range between $145 to $450 a month. The largest percentage of units seems to be in the 3-bedroom home (representing 72% of the units listed for rent) and in the 2-bedroom apartments (68% of the units listed).

The 1979 Housing Assistance Plan (HAP) reported that the housing stock total in Albuquerque was 123,661. Rental units totaled 55,634 and owned units 68,027. The rental vacancy rate was 4.2% which results in an estimated 2,337 rental units that are available. For owned units the vacancy rate is considerably less at 1.65%, which means that about 1,122 units are for sale. The large number of vacant rental units has generated a renters market wherein units are being offered with the first month 'rent-free' as an attempt to attract renters.

The condition of the housing stock in Albuquerque is described in the 1979 HAP. Housing suitable for rehabilitation totaled 4% of the housing stock; 195 units were designated substandard and 40 of these units are not recommended for rehabilitation*. The average age of housing in Albuquerque is 20 years.

III.B.9.3 Employment/Unemployment Status (AFERN 4.2.2)

In October 1979 the civilian labor force for the region was 207,000 and the number of persons employed was 195,900. A total of 11,100 persons were unemployed, resulting in an unemployment rate of 5.4%; this is comparable to the state-wide unemployment rate in the same period (5.8%).

*A unit is considered a viable candidate for rehabilitation if the structure has not deteriorated beyond 50% of its market value.

Table 18

Survey of Available Housing in the Albuquerque Area[1]

Homes for Sale

Bedrooms	Percent Distribution	Average Monthly Payment[2]	Price Range Low	Price Range Average	Price Range High
2	10	$478.15	$26,000	$56,024	$ 96,000
3	57	566.72	34,000	66,414	159,500
4	33	783.38	32,500	85,536	168,500
	100				

Homes for Rent[3]

Bedrooms	Percent Distribution	Average Monthly Rent	Rent Range
2	20	$247	$140 - 430
3	72	362	250 - 650
4	8	372	275 - 475
	100		

Apartments for Rent[3]

Bedrooms	Percent Distribution	Average Monthly Rent	Rent Range
1	28	$190	$110 - 325
2	68	230	145 - 450
3	4	339	150 - 475
	100		

(1) *Albuquerque Journal*, Sunday, February 17, 1980 and Albuquerque *Homes Illustrated* of January 19, 1980.

(2) Payment table for monthly mortgage loans based on a 30 year conventional loan, 20% down at 12½% interest, principal and interest only.
Source: First American Title Insurance Co.

(3) Unfurnished.

The distribution of the labor force in the region can be broken into seven major categories: manufacturing, construction, transportation and utilities, wholesale/retail trades, services (including miscellaneous), and government. The largest number of persons employed in both the Albuquerque Standard Metropolitan Statistical Area (SMSA) and in the state as a whole, is in the wholesale/retail trades, services and government. In a recent 1979 economic study (Ref.: "Overall Economic Development Program") by the Middle Rio Grande Council of Governments, it was stated that "although the Albuquerque area has a growing labor force both in numbers and diversity, the majority of the labor force is generally unskilled".

III.B.9.4 Local Economic Factors (AFERN 4.2.6)

The 1979 cost of living index for Albuquerque is compared in Table 12 with other cities of comparable size in the western United States. Albuquerque's data is repeated below.

All Index Items	Grocery Items	Housing	Utilities	Trans- portn.	Health Care	Misc. Goods & Services
105.9	104.5	110.0	114.7	104.6	103.3	97.6

The nation-wide cost of living index varies between 82.6 (at Shenandoan, Iowa) and 125.3 (at Palm Springs, California). Albuquerque's index average of 105.9 is higher than the national average of 100.0.

III.C Alternate 2 Location - Malmstrom Air Force Base, Great Falls, Montana

III.C.1 General Description of Region

Malmstrom Air Force Base in Great Falls, Montana has been selected as the second alternate location for the CSOC facility. The base is situated on the eastern city limits of Great Falls, north of U.S. Highway 87/89 which is locally named 10th Avenue South. Figure 12 shows the location of the base with respect to the local area.

Great Falls is located in north-central Montana on the borders of the Missouri River and it is the second largest city in the state with an estimated January 1980 population of 62,536. This represents 73 percent of the total county population. The growth rate in Great Falls has been below the nation's average at about about .5-1 percent yearly since 1970. Although it is a grain and milling center for the grain farms in the region, the major sources of employment are in the clerical and professional/technical fields.

Malmstrom AFB was established in 1943; concurrent with a long series of reductions in military missions over the past decade, the base work force has declined to its present level of 4,430 military and civilian employees.

As the major city in Cascade County, Great Falls has three accredited hospitals plus a number of highly-rated medical clinics. It is also the location of the State School for the Deaf and Blind and the Montana Rehabilitation Center for the treatment of crippled children and adults. It has a fairly new modern public library, 67 churches of all faiths, 400 clubs and organizations, the Charles M. Russell museum and art gallery, and other cultural, theatrical, concert and symphony facilities. Winter sports include two nearby ski and snowmobile areas. Outstanding hunting and fishing are available in the nearby region. Glacier National Park and Yellowstone National Park are both within several hours drive of Great Falls.

III.C.2 General Description of CSOC Location at Malmstrom AFB

Two optional siting arrangements are being considered for the CSOC if located in the Great Falls area. Both options utilize property and/or existing facilities at Malmstrom AFB.

Option A would require rehabilitation of the existing SAGE building for housing the engineering and administrative functions and for additional warehousing. A new Technical Building and additional powerplant structure would be constructed in the vicinity of the SAGE building. This option would require the demolition of about 10 existing buildings which are already scheduled for demolition as part of a base upgrading effort. Several of the base roads in the vicinity of the SAGE complex would need to be re-routed around the CSOC buildings to provide through traffic flow. The antenna field in Option A would be remotely located southeast of the base runway. Both the CSOC buildings in the SAGE area and the remote antenna field (as shown on Figure 13) would have to be enclosed with a security fence and patrol road, and equipped with a manned guardhouse at each location.

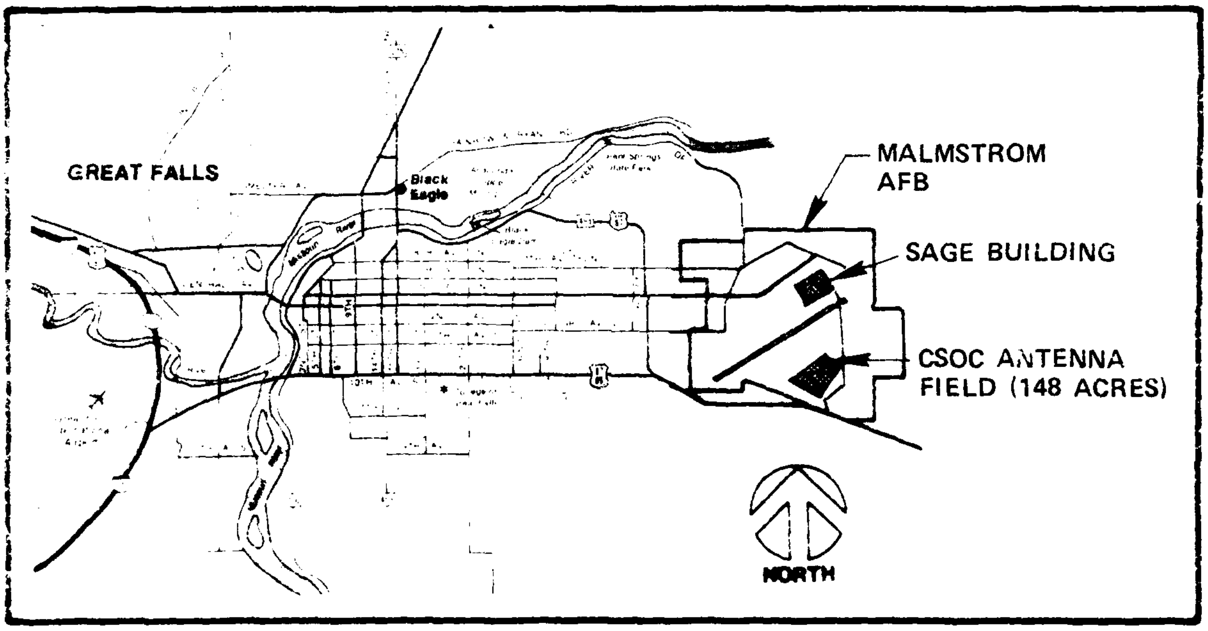


Figure 12 Location of Alternate 2 Sites at Malmstrom Air Force Base

FACILITY SITE PLAN

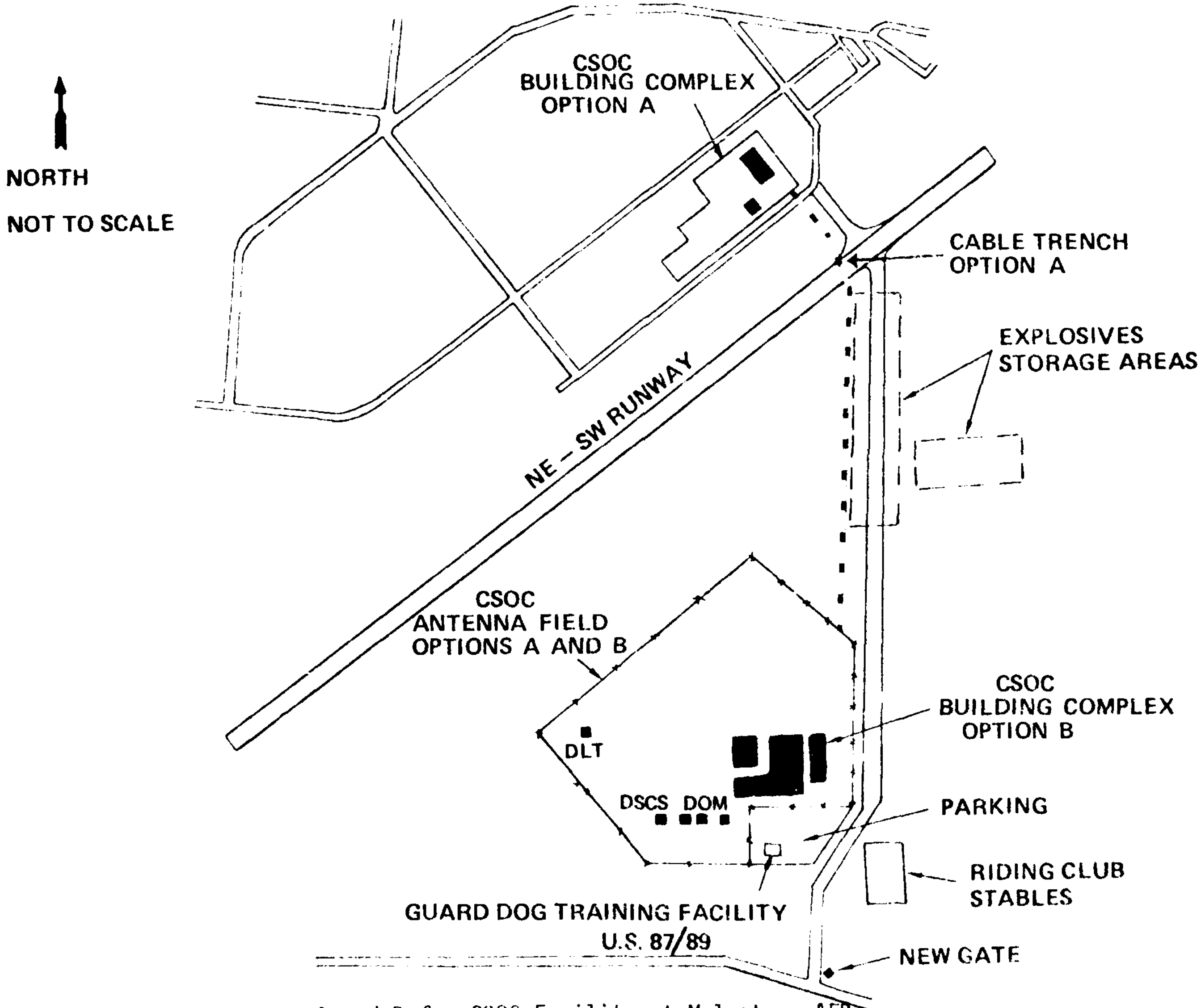


Figure 13 Options A and B for CSOC Facility at Malmstrom AFB

Option B involves placing the entire CSOC facility (including the antenna field) in the area southeast of the runway. Under this option the existing guard dog training facility identified in Figure 13 would have to be located elsewhere.

III.C.3 Existing Traffic Environment (AFERN 4.4.1.2)

Traffic impacts from this project will occur primarily in the immediate vicinity of the base; the three arterials that will receive the major traffic from CSOC include 2nd Avenue North, 10th Avenue South (U.S. 87/89) and 57th Street. The degree of impact on each of these three arterials is highly dependent on which option is selected since different base entry and exit gates utilizing different public roads would be involved.

Under Option A the 2nd Avenue North entry gate will be used by the CSOC employees housed in the SAGE area. If Option B is selected, a new manned entry gate will be built at U.S. 87/89 located about 1500 feet from the CSOC site. Under this option, traffic impact on and access to U.S. 87/89 becomes of paramount importance.

The latest 1978 traffic counts that are available for the roads and highways in the impacted area, are presented on Figure 14. Traffic congestion during peak base hours has been virtually eliminated with the completion in 1979 of a new signalization system and right-turn lanes at the intersection of 2nd Avenue North and 57th Street. U.S. 87/89 is presently an undivided 2-lane state highway; plans for rebuilding it to a 4-lane divided highway with limited access are included in the 1983 capital improvements budget. This improvement program includes the 9-mile section just east of the city limits where the proposed entry gate (in Option B) would be constructed off of U.S. 87/89. Approximately 10% of the 8,505 average daily traffic on U.S. 87/89 east of 57th Street, is comprised of grain and freight trucks, and oil trucks from nearby refineries.

Long-range plans beyond 1995 implementation include consideration of a 'South Bypass' arterial joining 57th Street with Interstate 15 on the southwest side of the city; this is shown in Figure 15. This arterial will provide an alternate route to major north/south streets in Great Falls and should enable more efficient travel to and from the southwestern portion of the city. The viability of this arterial has not yet been established.

Great Falls has no public bus system, therefore the only means of transportation to and from the base is via private automobile or taxi.

III.C.4 Existing Air Quality Environment (AFERN 3.3)

Great Falls is located in a highly favorable climate and topographical setting which inhibits deterioration of the air quality. Only a small section of downtown Great Falls has been designated as a non-attainment area and then only for violation of the total suspended particulates and carbon monoxide pollutants. However, there have been no violations in the past two years of the suspended particulate primary standard and the city has therefore requested attainment status for this category. Table 19 lists the primary and secondary ambient air quality standards that are applicable in the State of Montana.

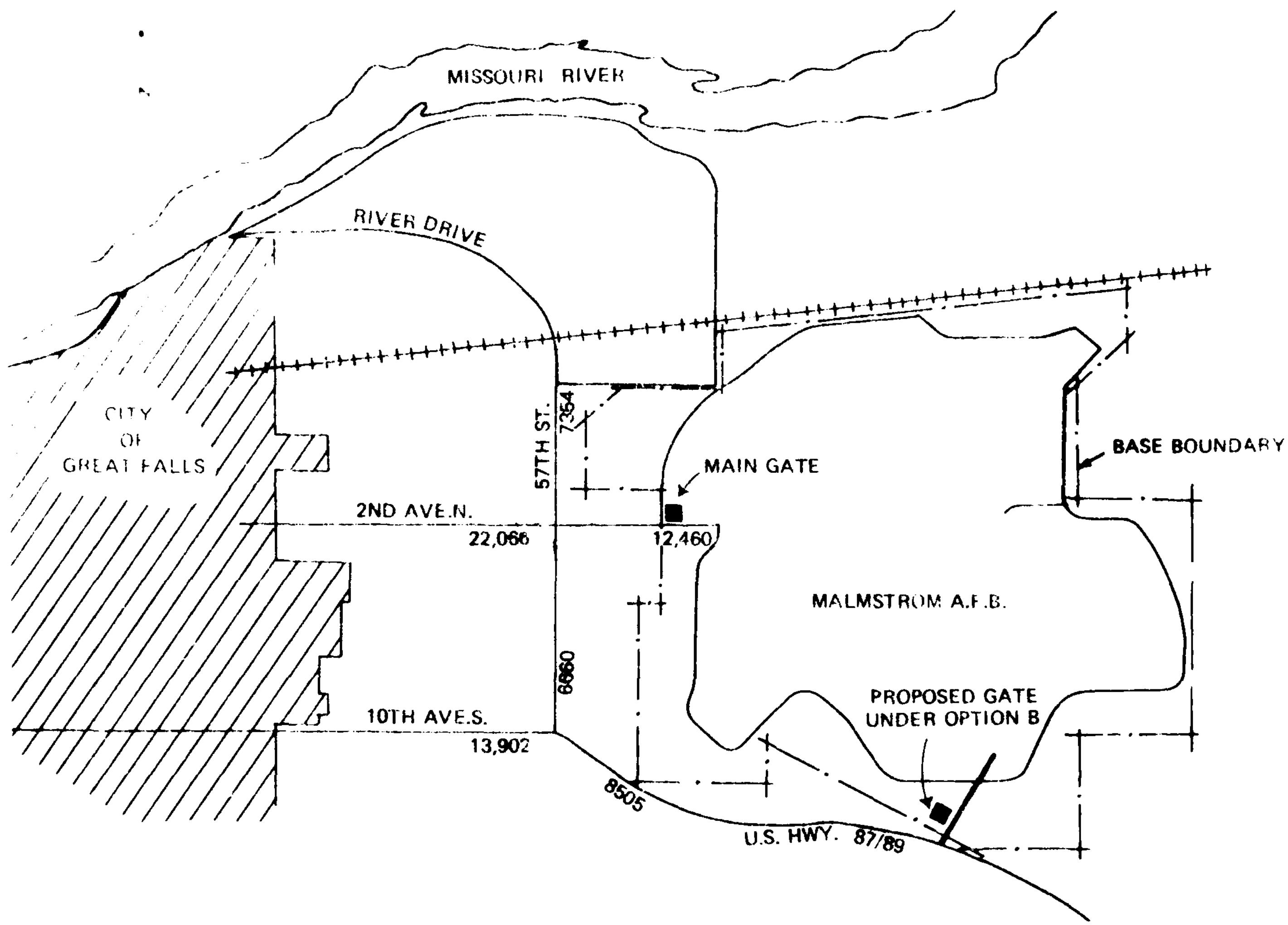


Figure 14 Existing Average Daily Trips in Vicinity of Malmstrom AFB

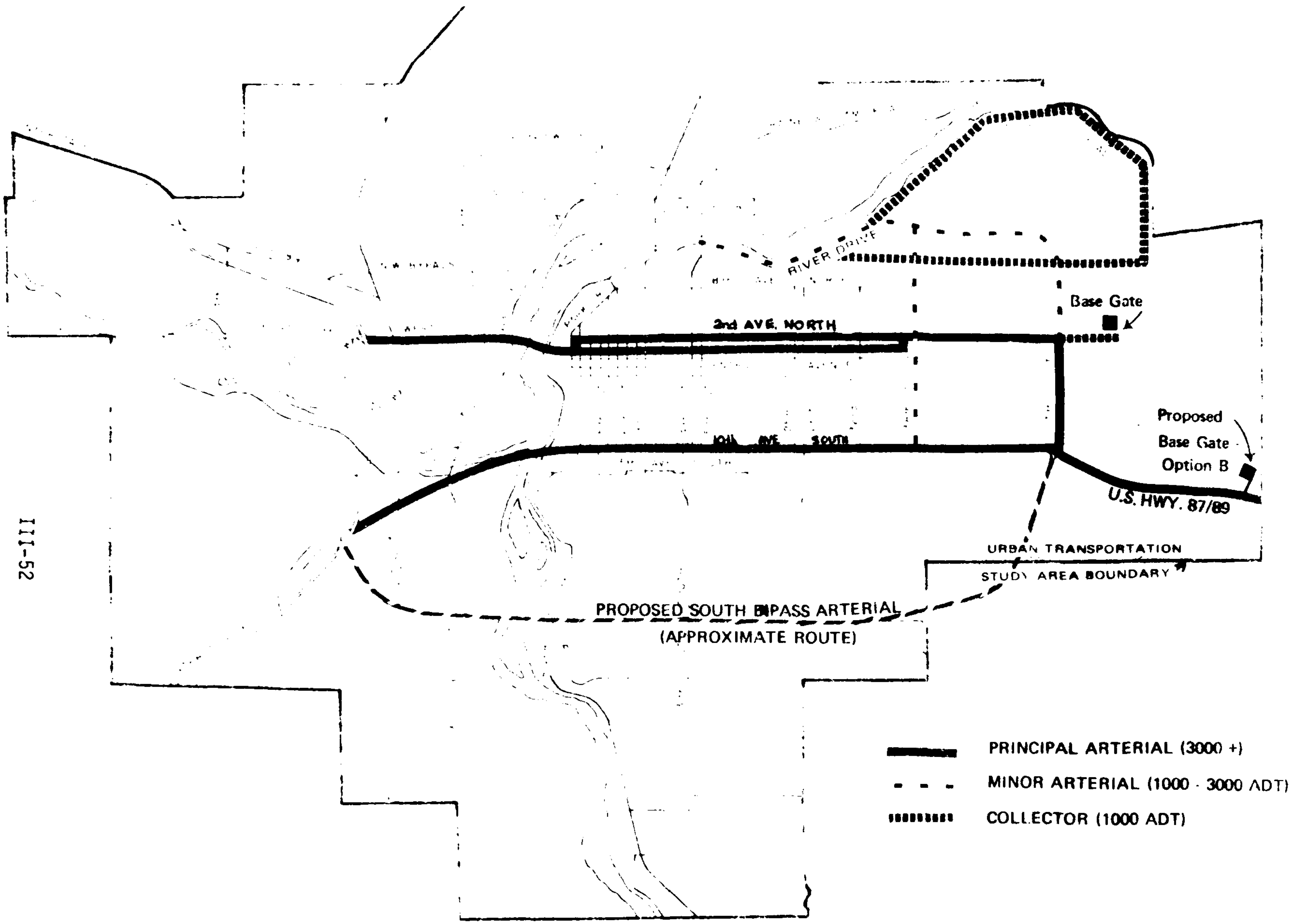


Figure 15   Proposed South Bypass Arterial in Great Falls, Montana

Table 19

State and Federal Ambient Air Quality Standards for Montana

Pollutant	Federal Primary Standard	Federal Secondary Standard	State Adopted Standard
Total Suspended Particulates			
24-Hour Average	260 $\mu g/m^3$	150 $\mu g/m^3$	200 $\mu g/m^3$
Annual Geometric Mean	75 $\mu g/m^3$	60 $\mu g/m^3$	75 $\mu g/m^3$
Sulfur Dioxide			
24-Hour Average	.14 ppm	--	.10 ppm
Annual Arithmetic Average	.07 ppm	--	.02 ppm
3-Hour Average	--	.5 ppm	--
Carbon Monoxide			
8-Hour Average	9 ppm	9 ppm	9 ppm
1-Hour Average	35 ppm	35 ppm	35 ppm
Photochemical Oxidants			
1-Hour Average	.12 ppm	.12 ppm	--
Nitrogen Dioxide			
24-Hour Average	--	--	--
Annual Arithmetic Average	.05 ppm	.05 ppm	--

The 1978 emissions inventory from stationary sources within the Great Falls area is included in Table 20. The carbon monoxide monitoring station located at 10th Avenue South and 9th Street registered violations of the national primary standards on 16 days between October 1977 and February 1979. The city is continuing to monitor carbon monoxide emissions at a new location on 10th Avenue South near 20th Street. There are in addition, 27 monitoring sites located within and around the city which measure reactive sulfur concentrations. Malmstrom AFB has also been conducting a monitoring program for reactive sulfur since October 1978. To-date there have been no recorded violations for nitrogen oxide, sulfur dioxide, or ozones.

Table 20

1978 Great Falls Emission Inventory - Stationary Sources

Pollutant	1978 Estimated Emissions (Tons/Year)
Total Suspended Particulates	422
Sulfur Dioxide	381
Nitrous Oxide	114
Carbon Monoxide	10576
Hydrocarbons	390

III.C.5 Utilities (AFERN 4.4.2.1 and 4.4.2.2)

Utilities must be supplied to the CSOC and additionally, to the CSOC employees and their families at their places of residence. In order to assess the maximum potential demand placed on the utility systems supplying Great Falls and Malmstrom AFB, it will be assumed for purposes of this report that all of the CSOC employees will be new residents moving into Great Falls. It is recognized that approximately 500 military and 60 civilian personnel could be leaving the Great Falls area in early 1982 due to deactivation of the SAGE program.

III.C.5.1 Water Resources (AFERN 4.4.2.1 and 4.4.2.2.1)

Great Falls obtains its water primarily from the Missouri River rather than from subsurface aquifers. This water is filtered and chlorinated at the Great Falls Water Treatment Plant, which is capable of treating up to 50 mgd. Water is considered to be of good quality though somewhat hard. Malmstrom AFB purchases its water directly from the city and presently uses about 1.2 mgd. Water is stored on base in two elevated 250,000 gallon tanks and two ground level tanks, for a total storage capacity of 2.2 million gallons. Additional water beyond the present 2.3 mgd supply can be delivered to the base if the base's 12-inch supply main is replaced with a 16-20 inch line.

The State of Montana allocates sufficient water to the city to support a population of about 1,000,000 persons; the present population is well under 100,000; thus water supply is not a limiting factor to future growth in the Great Falls area.

III.C.5.2 Wastewater Treatment Facilities (AFERN 4.4.2.1 and 4.4.2.2.2)

The Great Falls wastewater treatment plant has a secondary treatment capacity of 20 mgd. It is presently treating 8-9 mgd; discharge is to the Missouri River.

At the present time Malmstrom AFB operates its own treatment plant which was updated and modified in 1973 to treat 1 mgd and to meet the 1975 EPA criteria. The average daily flow presently is only about .85 mgd. Discharge from the base treatment plant is also to the Missouri River at a point approximately 1.5 miles north of the base. Because the base treatment plant is presently unable to meet the more restrictive 1977 EPA criteria, it will be abandoned and wastewater will then be handled by the city's sewer system and treatment facilities. This is scheduled to take place by October 1982.

III.C.5.3 Natural Gas Supply (AFERN 4.4.2.1 and 4.4.2.2.6)

Both the city and Malmstrom AFB are provided with natural gas by the Great Falls Gas Company, which in turn receives gas from two gas fields (operated by the Montana Power Company) through a distribution system originating in Alberta, Canada. Canada has enacted a program which calls for a reduction in the amount of gas sold to the United States beginning in 1985. Because of this eventuality, a central coal-fired heating plant is being planned for the base with a start-up date of September 1984. This plant will replace numerous existing individual gas-fired heating units presently in use.

III.C.5.4 Electrical Power Supply (AFERN 4.4.2.1 and 4.4.2.2.3)

The Montana Power Company provides electrical power service to the city and to Malmstrom AFB. Power is transmitted to the base from Rainbow Dam Hydroelectric Plant on the Missouri River northeast of town. (Great Falls is known as the "Electric City" due to the abundance of electrical power and water supplied by the Missouri River.) The base is supplied with about 10,000 kVA; current usage is 8,000 kVA.

III.C.6 Geology and Soils (AFERN 3.1.2 and 3.1.3)

The base is situated on top of a plateau which drops about 200 feet in elevation toward the Missouri River to the north, and slopes toward Great Falls on the west. There are no floodplain areas in the vicinity of either the SAGE building or in the area where the antenna field is proposed. The western portion of Montana is in Seismic Zone 2. Geologic faults, however, are not presently known to exist in the regional vicinity. Previous test drilling on the base has indicated clayey material to a depth of 50 feet; it is estimated that bedrock depth is between 80 and 100 feet.

The site for the antenna field (in Option A) and the entire facility (in Option B) southeast of the runways is characterized by the Lan-dusky-Gerber-Belt soils association. These soils are found on nearly level to rolling glacial plains and consist of dark colored silty clay loam surface soils over brown, strong blocky, silty clay subsoils. These are highly expansive soils which have in the past caused numerous foundation problems and could easily cause foundation distress at the CSOC facilities unless care is taken during construction to maintain specific moisture content and not allow the soil to dry or become excessively wet. Depending on the type of foundation system employed, frost penetration could also be a problem. Additionally, these soils possess corrosive materials which have caused problems elsewhere on the base with various subsurface steel or ferrous utility structures. This soil characteristic will have to be considered in the design of utilities and other subsurface structures.

III.C.7. Meteorology (AFERN 3.3.1)

The climate in Great Falls is heavily influenced by its location with respect to the Rocky Mountains. Maritime air masses are subject to lifting and sinking as they cross the Continental Divide in the western part of Montana. As a result, these air masses usually contain very little moisture by the time they reach the Great Falls area. The winter climate is dominated by the Arctic high-pressure systems which result in occasional strong surface inversions. Chinook winds (warm and dry, gusty winds which descend on the lee side of the Rockies) occur frequently during the winter and effectively breakup the inversion. Table 21 contains recorded climatological data measued over the past 25-30 years.

Mean daily maximum temperatures in July and January are 82°F and 29°F; mean daily minimums in July and January are 55°F and 10°F respectively. Extreme temperatures are 106°F and -44°F. Temperatures over 90°F are relatively infrequent, but days less than 32°F total more than 150 days a year. Mean monthly relative humidities vary from a low of 45% in August to a high of 64% in January, February and March.

Table 21

Climatological Data in Great Falls

	J	F	M	A	M	J	J	A	S	O	N	D	Yrs Rec
Temperature (°F)													
Highest	65	68	76	86	92	96	102	106	96	90	75	64	30
Mean Daily Max.	29	37	41	54	64	71	82	82	70	60	44	35	30
Mean Daily Min.	10	17	21	32	42	49	55	54	45	37	25	17	30
Lowest	-36	-24	-31	-4	14	29	35	38	20	0	-19	-44	30
Mean No. of Days													
Max. Temp. $\geq$ 90°F	0	0	0	0	X	1	7	7	1	X	0	0	30
Min. Temp. $\leq$ 32°F	27	24	25	15	3	X	0	0	2	9	20	26	30
Precipitation													
Mean (Inches)	.8	.6	.8	1.0	2.4	3.0	1.2	1.2	.9	.7	.7	.7	30
Mean No. of Days $\geq$0.5"	X	X	X	X	1	2	1	1	X	X	X	X	30
Snowfall													
Mean (Inches)	9	7	8	6	1	X	X	X	1	2	7	7	27
Mean No. of Days > 6"	2	1	2	1	X	X	0	0	X	X	2	2	27
Relative Humidity (%)													
Mean	64	64	64	57	55	58	47	45	51	53	60	63	30

Maximum 24 Hour Precipitation 3.20 inches 30 years of record.
Maximum 24 Hour Snowfall 15.5 inches 30 years of record.
Flying Weather - Annual Percentages for Various Categories.

A. Ceiling $\geq$ 1000 Feet and Visibility $\geq$ 3 Miles.
B. Ceiling 500-900 Feet and Visibility $\geq$ 1 Mile or Visibility $\geq$ 1 Mile but < 3 Miles and Ceiling $\geq$ 1000 3.1%
C. Ceiling < 500 Feet and/or Visibility < 1 Mile 2.1%

X indicates less than one

Source: U.S.A.F. ETAC (Environmental Technical Applications Center), Scott AFB, Illinois.

Monthly rainfall rates vary from 3.0 inches in June to .6 inches in February. Maximum 24-hour rainfall over the past 30 years was 3.2 inches. Snowfall has occurred in every month, with traces in June, July and August. The heaviest snowfalls occur on the average in January (9 inches) and March (8 inches).

Average cloud cover for the year is 61% with December through May being the cloudiest months. The principle sector for cloud buildups is southeast through west in the mountain ranges. In summer, cloud tops range from 8° to 15° elevations to the southwest and west with heights up to 35,000 feet.

Prevailing wind is from the southwest with an average speed of 7 to 11 knots. Maximum gusts generally occur during winter storms but may accompany a summer thunderstorm. Gusts of greater than 50 knots have occurred in every month with an extreme of 78 knots.

Great Falls averages about 25 thunderstorm days per year with the majority occurring between May and August (89% occur in this period). Icing conditions from freezing rain or drizzle have occurred during 8 months of the year with the most likely occurrence in October, December, January and April. Fog occurs year-round but is most likely in October through April. Severe thunderstorms, tornados, and dust storms are relatively rare in this area.

III.C.8 Socioeconomic Environment (AFERN 4.1, 4.2, 4.3)

III.C.8.1 Education (AFERN 4.3.3)

The Great Falls Public School District is comprised of 16 elementary schools, 4 junior highs and 2 senior high schools. The January 1980 student enrollment was 6,632 in Grades K-6; 3,185 in Grades 7-9; 3,451 in Grades 10-12. Total student enrollment was 13,268 in 1980. The district had a peak enrollment of just over 19,000 students in 1970, but this has steadily declined to the present level even though the population of Great Falls has increased in the same period. The district has projected a further decline through 1984 to 12,510 students, followed by a slight increase in 1985. The student population projections are included in Table 22. As a result of this downward trend, five elementary schools have been closed (in 1979); two of these facilities remain unused while the remaining three are being used for other purposes.

Table 22

Student Population Projections

in

Great Falls Public School District

Grade Level	1981	1982	1983	1984	1985
K-6	6,732	6,540	6,423	6,597	6,763
7-9	3,085	3,046	3,112	3,104	2,996
10-12	3,282	3,070	2,997	2,809	2,804
Total Yearly Enrollment	13,099	12,656	12,532	12,510	12,563

Five private parochial schools with a capacity for housing 1,500 K-9 students, are located in the Great Falls area. These schools are substantially under capacity at the present time.

The College of Great Falls is the only institute of higher education located in the vicinity. It is a 4-year private school with an enrollment of about 1,200. Graduate courses are offered in cooperation with the University of Montana, University of Southern California, and Pepperdine University. The College also offers under-graduate courses on-base which are open to civilians as well as military personnel.

III.C.8.2 Military and Civilian Housing (AFERN 4.2.5)

III.C.8.2.1 Military housing (AFERN 4.2.5.4)

Malmstrom AFB has a total of 3,140 quarters for permanently assigned officers and enlisted personnel. There are 1,406 family units, 68 bachelor officer units, and 1,666 enlisted or bachelor airmen units. In addition to these permanent quarters there are units available for temporary housing; these include the 43 visiting officer quarters and 40 temporary lodging quarters available to both officer and enlisted personnel. The following is a listing of military quarters on the base by rank, type, and total spaces or units in each category.

Qualifying Personnel	Family Units	BOQ	BAQ	VOQ	Temporary Lodging
Officers	294	68	---	43	--
Enlisted	1,112	--	1,666	--	--
Officers and Enlisted	---	--	---	--	40

Family Housing

Family units on Malmstrom are 17 to 28 years old and all are in good condition. At the present time there are 294 units for officers and 1,112 for enlisted personnel. The waiting period for officer's quarters is 1 to 4 months; the average waiting period is about 3 months. For enlisted personnel, the waiting period is about the same as for officers housing. As of February 1980 all family quarters were occupied; this included 200 ineligibles (i.e. enlisted personnel in ranks normally ineligible for family quarters). There are no plans at this time to increase the number of family housing units.

In addition to family quarters, Malmstrom has a mobile home facility with 165 spaces for privately-owned mobile homes. The monthly charges total $19.22 and the facility is open to officers and enlisted, married or single. At the present time 135 of these spaces are occupied.

Bachelor Housing

The 1,734 bachelor quarters on Malmstrom are divided into 68 units for officers and 1,666 for enlisted personnel. In February 1980 all officers quarters were occupied and 1,406 of the enlisted BAQ spaces were taken; the remaining 260 unoccupied units are available for enlisted occupancy.

III.C.8.2.2 Civilian Housing (AFERN 4.2.5.1)

Table 23 lists information that was obtained from local newspapers and real estate publications that list housing units for rent and for sale. From this information it was determined that the average 3-bedroom home sells for $60,900; sales prices range, however, between $31,000 and $125,000. In February 1980 over 100 3-bedroom homes were listed for sale. The rental market also provides a wide selection of reasonably-priced housing. The average 3-bedroom home, for instance, rents for $308 per month and the average 2-bedroom apartment rents for about $230 a month.

The 1979 Housing Assistance Plan reported that the total housing stock in Great Falls was 24,129 units. Rental units totaled 10,072 and owned units 14,057. The vacancy rate for rental units was 10% which indicates that slightly over 1,000 units are vacant and presumably available for renting. The vacancy rate for owned units was also 10%, resulting in about 1,400 units for sale. The unusually high vacancy rate of 10% for both owned and rental units, is attributed to several factors: 1) a large number of residential units were built in 1978 and 1979, 2) the decline in the labor force at Malmstrom which also occurred in 1978 and 1979, and 3) currently high interest rates which tend to reduce home purchases and also affect the rental rates of newly-constructed apartments. As an example, an apartment complex that opened in 1979 only had 30% of its units occupied one year later — a strong indication that the present housing situation in Great Falls is a case of more supply than demand.

Based on information obtained from the 1979 HAP, the housing stock in Great Falls contains 1,689 units (7% of the total stock) that are suitable for rehabilitation. There are additionally 269 substandard units with 19 of these considered unsuitable for rehabilitation.

III.C.8.3 Employment/Unemployment Status (AFERN 4.2.2)

In November 1979 the civilian labor force in the Great Falls area was 33,700 — a decrease of 2,600 from the November 1978 labor force of 36,300. The number of persons employed in November 1979 was 31,600; 2,100 were unemployed. The unemployment rate corresponding to these figures is 6.3%. This is higher than the state-wide unemployment rate during the same period of 5.1%. The recent increase in unemployment is due in part to labor force decreases at Malmstrom AFB.

The four major categories of employment in the Great Falls region are Mining and Manufacturing, Wholesale Trades, Retail Trades, and Services.

III.C.8.4 Local Economic Factors (AFERN 4.2.6)

Great Falls reported a 1979 cost of living overall index of 94.9 which is 5.1 points below the nation-wide average of 100.0. This means that goods, services, etc., cost less in Great Falls than in the typical American city. The specific cost of index distribution for Great Falls is:

All Item Index	Grocery Items	Housing	Utilities	Trans-portn.	Health Care	Misc. Goods & Services
94.9	107.5	80.7	66.3	105.1	95.6	109.7

Table 23

Survey of Available Housing in the Great Falls Area[1]

Homes for Sale

Bedrooms	Percent Distribution	Average Monthly Payment[2]	Price Range Low	Price Range Average	Price Range High
2	15	$327.44	$14,500	$37,000	$ 55,900
3	45	539.01	31,000	60,900	125,000
4	34	607.31	33,500	68,600	135,000
5	6	719.59	56,500	81,300	99,500
	100				

Homes for Rent[3]

Bedrooms	Percent Distribution	Average Monthly Rent	Rent Range Low		Rent Range High
1	15	$148	$112	-	$180
2	55	211	125	-	300
3	27	308	175	-	375
4	3	388	375	-	400
	100				

Apartments for Rent[3]

Bedrooms	Percent Distribution	Average Monthly Rent	Rent Range Low		Rent Range High
1	31	$170	$ 75	-	$225
2	69	230	125	-	400
	100				

(1) Great Falls Tribune, Tuesday, February 5, 1980 and Great Falls Homes and Real Estate, January 23, 1980.

(2) Payment table for monthly mortgage loans based on a 30 year conventional loan, 20% down at 13% interest, principal and interest only. Source: First American Title Insurance Co.

(3) Unfurnished.

IV. ENVIRONMENTAL CONSEQUENCES

IV.A Direct and Indirect Effects and Their Significance

The following assessment addresses only those impacts that are considered as potentially adverse. Impacts that are population-related (such as air quality, traffic, schools, housing) have been evaluated using a maximum incoming CSOC population of about 6100 persons added to the current population at each of the candidate locations. This figure of 6100 persons is derived from the 2000 CSOC military and civilian personnel and their families, using a ratio of 2.2 dependents per employee. Although a recent base realignment at the Peterson AFB/Colorado Springs location, and one planned for 1982 at Malmstrom AFB will cause the base and local populations to decrease, for purposes of determining a 'worst case' impact, local population figures have not been adjusted for these base realignments.

IV.A.1 Traffic Impacts

IV.A.1.1 Traffic Generation of CSOC Project

The CSOC will have a maximum employment of 1,963 persons, of which 318 are expected to be military personnel and the remainder will be civilians. As a worst-case situation, it is assumed that all 1,900 employees will be new to each candidate location and will therefore establish a household in the respective metropolitan areas. Each household will generate approximately 10 trips per day, of which 1.62 trips will be made to the CSOC site. The remaining trips (totalling about 15,900 trips per day) will be made on the existing street systems in the respective metropolitan area. The additional 15,900 vehicular trips when added to the present street systems at either of the candidate locations, is considered nominal when distributed over the metropolitan area. The impact of this increase in traffic will not be discernable to the average driver.

The maximum number of employees expected to be present at each of the shifts at the CSOC site are as follows:

Day Shift	1,000 persons
Swing Shift	500 persons
Night Shift	500 persons
TOTAL	2,000 persons

Daily trip generation data, as collected and published by ITE*, suggest that a daily trip rate of 1.8 trip ends per employee per day, 90 percent of which are employees and 10 percent are visitors, might be expected at a facility of this type. This generation rate suggests that only one auto in four has a passenger. Based upon this auto occupancy rate, the following are the number of vehicles that might be expected to arrive at the peak periods:

Peak Periods	Inbound	Outbound
AM Peak Hour (Shift Change)	810 Trips	200 Trips
PM Peak Hour (Shift Change)	200 Trips	810 Trips
End of Swing Shift (Shift Change)	200 Trips	200 Trips
Off-Peak (8 am - 5 pm)	135 Trips	135 Trips

* "Trip Generation, An Informational Report", Institute of Transportation Engineers, 1979.

IV.A.1.2 Traffic Impacts at Peterson AFB/Colorado Springs Location

The proposed CSOC sites (i.e., Sections 24 and 26) are presently unimproved and therefore do not generate traffic. Access to Section 26 is via Highway 94, an east-west arterial, then south along Enoch Road approximately two miles. Section 24 lies just east of Section 26 and presently does not have vehicular access. (NOTE: If Section 24 is selected for the CSOC, vehicular access would have to be acquired from either Highway 94 or Enoch Road.) Traffic volumes are relatively low on Highway 94 east of Peterson Road. By mid-1980 coal-carrying trucks will begin using Highway 94 (estimated to be 150 trucks per day) between Franceville Road and Colorado Springs. Although the volume of trucks is not great, their speed will be slow due to their weight. The State Highway Department has included construction of a passing lane in the vicinity of Franceville Road as part of their improvement program.

Peterson Road is the main access street to Peterson AFB and accommodates peak-hour volumes of approximately 4,100 vehicles inbound in the am and 4,100 vehicles outbound in the pm peak hour. Volumes of this magnitude can be accommodated through a traffic signal with a level of service in the E* range for short periods in the evenings and in the D range in the morning. These service levels represent conditions of congestion for short intervals during the peak periods.

The most recent traffic counts on roads to be affected by the CSOC location are as follows:

State Highway 94 at Enoch Road	1,200 ADT**
State Highway 94 east of Peterson Road	3,000 ADT
State Highway 94 west of Peterson Road	13,000 ADT
Enoch Road south of State Highway 94	100 ADT
Peterson AFB Main Gate	4,100 VPH*** (Peak Hour)

It should be noted that traffic volumes increase markedly at Peterson Road which serves as the main entrance to the base. East of Peterson Road the predominant traffic is of the farm-to-market nature, with approximately 2.4 percent trucks.

It is estimated that a high percentage of the project traffic will use the Highway 94/Peterson Road intersection and thus compete with Peterson AFB employees for available intersection capacity. During the am and pm peak periods, the project will introduce approximately 810 vehicles per hour in the heavier direction. If the peak periods of the CSOC correspond to the peak hours at Peterson AFB, a capacity deficit could occur at this intersection, creating delays during these intervals. Should congestion develop at this intersection, consideration should be given to addition of a lane for either northbound or westbound traffic.

During the evening peak exiting period at the CSOC location, traffic control devices may be necessary at the intersection of Highway 94/Enoch Road, to enable the 810 vehicles to safely enter Highway 94. The amount of conflict

*See Appendix B for definition of service levels.
**Average daily traffic, two-way travel over a 24-hour period.
***Vehicles per hour during the peak hour, one direction only.

will be dependent upon two variables: 1) amount of through traffic on Highway 94, and 2) amount of car or van pooling. During the morning peak period, 810 vehicles will make a right turn from Highway 94 to Enoch Road. Because of the right-turning maneuver, capacity of the intersection will not be overtaxed.

IV.A.1.3 Traffic Impacts at Kirtland AFB/Albuquerque Location

The main portion of the CSOC facility (excluding the antenna field) will be located in the Manzano Area of Kirtland Air Force Base. The antenna field would be built at a site about 2 miles southeast of the Manzano Area with vehicular access via Lovelace Road (an extension of Pennsylvania Avenue) and Coyote Springs Road. Kirtland Air Force Base presently uses five entrance gates; employees and visitors to CSOC would travel through the main gates and base area to Pennsylvania Avenue and thence to the Manzano Area located about 4.5 miles from the main part of the base. Although existing traffic volumes are light on the south end of Pennsylvania Avenue (in the vicinity of the CSOC), volumes on the base streets increase markedly north of O Street. The present base command has therefore implemented staggered work schedules in addition to making many of the base streets one-way in an effort to minimize peak hour congestion within the main compound area.

Pennsylvania Avenue is also the military convoy route to the munitions storage area at Manzano. During those periods of a convoy, all other traffic must yield to the convoy vehicles. This should not present more than an occasional interruption to CSOC traffic, particularly in the off-peak period (8 am to 5 pm) when an average of 30 vehicles per hour (15 in and 15 out) come and go from the CSOC. A convoy during this period would not present a congestion problem, but could be considered an inconvenience to visitors.

During the peak am and pm periods at Kirtland AFB, delay is encountered entering and leaving the main gates. Based upon peak-hour traffic counts, traffic distribution at the five base gates would be distributed as noted in Table 24 on the following page. If CSOC employees are allowed unrestrained use of any of the base gates, commuters during both the am and pm peaks will experience delay north of O Street within the cantonment area. Because five main access gates are available it is anticipated that the 810 vehicles per hour will be distributed such that the maximum impact will be 240 vehicles per hour on Wyoming Boulevard. During the peak period it is expected that CSOC will add approximately six vehicles per minute. This additional volume at the Wyoming Gate will change the volume/capacity ratio (v/c) for inbound traffic from approximately .88 to .94, or approximately one-half of a service level. Because there are three lanes outbound at the Wyoming Gate, the v/c ratio will be much less, changing from .50 to .55. These v/c ratios suggest a relatively free flow.*

*Corroborated by discussions with Kirtland AFB security officer on 10 June 1980.

Table 24

Peak-Hour Traffic at Kirtland AFB

Gate	24-Hour Volume Both Directions	Inbound AM - Peak		Outbound PM - Peak	
		Current Vehicles	CSOC[1] Vehicles	Current Vehicles	CSOC[1] Vehicles
Wyoming	21,800	3,160	240	2,720	240
Gibson	20,600	2,880	230	3,810	230
Truman	18,000	2,160	190	2,160	190
Eubank	3,000	1,170	30	1,080	30
Carlisle	10,900	1,910	120	1,740	120
		11,280	810	11,510	810

[1] Estimated to be added as a result of the project. Distribution is in the same proportion as the traffic at each gate is to the total traffic at all gates.

The anticipated increase of 230 vehicles per hour on Gibson will increase the morning v/c ratio from .80 to .86. However, such an increase suggests that the 230 additional vehicles can be accommodated without introducing delays, although travel speeds may slow slightly. Although the evening outbound volume is greater than the morning, the three outbound lanes suggest a v/c ratio of .71 increasing to .75, which suggest relatively free flow*.

Addition of 190 vehicles per hour to the Truman Gate will increase the v/c ratio from .60 to .65 which suggests there will be no discernable change in travel speed or congestion along the streets leading to this gate. The Eubank and Carlisle Gates will receive a lesser amount of traffic, 30 and 120 vehicles per hour, respectively, and thus will be affected even less by project travel.

In summary, peak hour travel speeds on Pennsylvania Avenue and Wyoming Boulevard within the base, are relatively slow but drivers experience only moderate congestion, particularly during the morning peak period. Travel time from the CSOC site to the various gates after addition of CSOC traffic cannot be estimated with any degree of accuracy. Addition of project traffic will increase the amount of congestion slightly unless CSOC employees use the Eubank Gate, in which case there will be no diminution in travel speeds or travel conditions on the main base streets.

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If Eubank Gate is to be used by the CSOC employees, a new paved street would be required to connect this gate with the CSOC. Traffic control measures may also be required at the tee intersection of Eubank Boulevard and east G Street, particularly for evening traffic.

The Middle Rio Grande Council of Governments has adopted plans for an expressway extending from the Gibson/I-25 interchange easterly to the Central Avenue/I-40 interchange. This is called the "Gibson East Corridor" and is tentatively scheduled for construction sometime within the next 5-10 years. It will relieve traffic at most of the base entry gates as well as reduce peak hour congestion on the base streets.

Public bus transportation is available in Albuquerque and is used by a number of Kirtland base employees commuting to work. However, in order to make this form of public transportation feasible for the CSOC employees, a shuttle vehicle would be needed to provide transportation between the public bus stops at the base gates and the CSOC site located some 4-6 miles from the nearest gate.

IV.A.1.4 Traffic Impacts at Malmstrom AFB/Great Falls Location

Access to the Option A site (the SAGE building area) would be via the Malmstrom AFB 2nd Avenue North gate. CSOC employees would therefore be adding to the present traffic volumes at this entrance. Should the Option B site be selected, it is proposed that a new gate be constructed immediately south of the antenna field, thus allowing direct access onto U.S. 87/89 and precluding the use of the 2nd Avenue North gate.

IV.A.1.4.1 Option A Traffic Impacts

The latest available peak hour traffic data listed below was obtained in November 1975 and are included in the Military Management Command Report No. 75-36. Although the report is approximately 4 to 5 years old, the base population is about the same now as it was in 1975. The data below can therefore be considered representative of today's traffic volume at the 2nd Avenue North gate.

	Existing Traffic	CSOC Traffic	Total Traffic	Percent Increase due to CSOC Traf.
Peak am Hour-Inbound	830	810	1640	98%
Peak pm Hour-Outbound	760	810	1570	107%

Inasmuch as the CSOC employees will enter and leave during the same peak hour period as do the Malmstrom AFB employees, congestion could be experienced at the 2nd Avenue North gate. The base presently has staggered working hours to minimize base traffic congestion and car pooling is encouraged. It is assumed that CSOC employees would also take part in the flexible work hours program and car pooling.

An hourly volume of 1640 vehicles can be accommodated in a two-lane approach to a traffic signal if approximately one-half of the signal's green time is assigned to that approach. Therefore the service level at the intersection of 2nd Avenue North and 57th Street should remain at a non-congested level. Off-peak volumes will be nominal and will have no discernable impact on service levels on the nearby streets or at the 2nd Avenue North gate.

Vehicular travel between the SAGE area and the antenna field must cross the end of the runway and pass through the explosives storage area, both of which could be impediments to safe travel. On the other hand, there will be a minimal amount of travel by CSOC employees to the antenna field and for this reason, the aforementioned concerns should not be a significant problem.

IV.A.1.4.2 Option B Traffic Impacts

U.S. 87/89 is presently a two-lane undivided federal highway serving approximately 8500 vehicles per day, an estimated 10% of this traffic are trucks. Plans for rebuilding the highway to four lanes, divided with limited access, are proposed in the 1983 federal highway capitol improvements budget. This project would include that section of the highway in the vicinity of the proposed new gate. The data below presents current traffic volume on U.S. 87/89 during the peak am and pm hours, and the added traffic volume due to the CSOC project.

	Existing Traffic	CSOC Traffic	Total Traffic	Percent Increase due to CSOC Traf.
Peak am Hour - Inbound	510	810	1320	159%
Peak pm Hour - Outbound	510	810	1320	159%

Although the percentage of added traffic is quite high, CSOC traffic could be accommodated by a traffic signal on U.S. 87/89 if there are provided four lanes of travel plus a left-turn lane on U.S. 87/89, and a single exit lane out of the CSOC facility. Such a configuration would provide a service level in the D range*. Service level to the high B or low A range could be achieved by providing in addition to the signalized intersection, dual exit lanes from the CSOC facility.

IV.A.2 Air Quality Impacts

IV.A.2.1 Motor Vehicle Emissions

The potential long-term air quality impact associated with implementation of the CSOC project is primarily related to emissions from the increased use of motor vehicles by CSOC personnel and their families. The estimated increased emissions related to motor vehicle use for all three locations, are tabulated in Table 25 on the following page. The emission factors used in Table 25 are based on EPA Mobile Source Emission Factors (EMFAC 5) for 1986 assuming 83% light duty automobiles, 12.5% light duty trucks, 1.5% medium duty trucks, 1.8% heavy duty trucks, and 1.2% motorcycles. Average vehicle miles traveled per day were estimated for each of the three candidate locations; 62,490 at Peterson AFB/Colorado Springs; 61,050 at Kirtland AFB/Albuquerque; 26,660 at Malmstrom AFB/Great Falls.

The emissions tabulated in Table 25 equate to a total of 536 Tons/year for the Colorado Springs location, 523 Tons/year for the Albuquerque location, and 225 Tons/year for Great Falls.

*Service Level as defined in the Highway Capacity Manual of 1965.

Table 25

Estimated Motor Vehicle Emissions from CSOC Project at CSOC Candidate Locations

Pollutant	Emission Factor gms/mile	Total Motor Vehicle Emissions					
		Peterson AFB/ Colorado Springs		Kirtland AFB/ Albuquerque		Malmstrom AFB/ Great Falls	
		lb/day	Tons/yr	lb/day	Tons/yr	lb/day	Tons/yr
Carbon Monoxide	17.4	2394	436	2340	427	1009	184
Hydrocarbons	1.4	193	35	188	34	81	15
Nitrogen Oxides	2.1	289	53	282	51	113	21
Sulfur Oxides	.15	21	4	20	4	8	2
Particulates	.3	41	8	40	7	16	3
TOTAL			536		523		225

IV.A.2.1.1 Impact of CSOC Motor Vehicle Emissions at Peterson AFB/ Colorado Springs Location

The total emissions of 536 Tons/year equate to roughly .2% of the reported 1974 emissions in the Colorado Springs AQMA. While this may be considered an insignificant increase, it still represents an addition to the present emissions and contributes to the worsening of the air quality. Car and van pooling will therefore be encouraged to minimize this impact.

The existing average daily traffic (ADT) of 3000 vehicles on Highway 94 east of Peterson Road could nearly double as a result of the CSOC. However, the projected ADT of 5700 vehicles will not present any air quality problems alongside the roadway. Car and van pooling will reduce this impact on Highway 94.

IV.A.2.1.2 Impact of CSOC Motor Vehicle Emissions at Kirtland AFB/ Albuquerque Location

The CSOC motor vehicle emissions of 523 Tons/year represent approximately .14% of the reported emissions in 1978 in the Albuquerque-Bernalillo Air Quality Control Region. While this is certainly not a significant increase, it nevertheless is an addition to the air pollutants in the region. For this reason, and to conserve gasoline, car and van pooling will be encouraged.

IV.A.2.1.3 Impact of CSOC Motor Vehicle Emissions at Malmstrom AFB/ Great Falls Location

The estimated CSOC motor vehicle emissions amount to roughly 225 Tons/year, or 1.9% of the 1978 reported emissions for the Great Falls area. While this does not represent a significant impact on the region's air quality, it is important that the CSOC population be encouraged to carpool and exercise every opportunity to reduce use of the private automobile.

IV.A.2.2 Impact of Household Emissions at CSOC Candidate Locations

The combustion of natural gas for space heating and water heating within the CSOC personnel dwelling units (1900 households) will also result in emissions of air pollutants. The estimated emissions from the use of natural gas are presented in Table 26; within the accuracy of these estimates and based on a natural gas consumption rate of 20,000 cubic feet per month per dwelling unit at all three candidate locations, the information contained in Table 26 approximates the natural gas emissions at all locations considered.

Table 26

Emissions from Natural Gas Combustion in CSOC Households

Pollutant	Emission Factor* lbs/1000 cuft	Total Emissions lbs/day	Tons/yr
Carbon Monoxide	.020	25	4.6
Hydrocarbons	.008	10	1.8
Nitrogen Oxides	.080	101	18.0
Sulfur Oxides	.0006	1	.2
Particulates	.005	6	1.1
TOTAL			25.7

*Table 1.4-1, Compilation of Air Pollutant Emission Factors, AP-42, 2nd Edition, February 1976.

The total emissions generated by natural gas combustion in 1900 CSOC households are estimated to be 25.7 Tons/year. This represents less than a .01% increase in total emissions at both the Colorado Springs and Albuquerque locations, and a .22% increase at Great Falls.

IV.A.2.3 Diesel Generator Emissions

Emergency electrical power for the CSOC facility is to be supplied by nineteen (19) diesel generators of 750 kVA output each, or 1000 hp. Other than during emergencies, the generators are to be operated only about 15 minutes each month to insure their optimum performance and reliability. Based on EPA emission factors* for diesel-powered industrial equipment (i.e., 33.5 pounds of particulate and 31.2 pounds of sulfur dioxide and 469 pounds of nitrogen oxides per 1000 gallons of fuel oil consumed), each diesel generator would produce 26 lbs/hour of particulate emissions and 24.2 lbs/hour of sulfur dioxide emissions and 364 lbs/hour of nitrogen oxides, assuming the generators would have to operate for at least a one-hour period under an emergency condition.

*Compilation of Air Pollutant Emission Factors, AP-42, Table 3.3.3-1, February 1976.

IV.A.2.3.1 Conformance with EPA Standards

The Environmental Protection Agency prepared new source performance standards for stationary combustion engines on July 23, 1977. The standards exempt standby diesel electric generators where such generators are only to be used in cases of emergency such as loss of the primary power source. Furthermore, because the generators are only to be used under emergency conditions, a permit would not be required under the EPA Prevention of Significant Deterioration program. No other federal emission standards are applicable to the diesel electric generators.

IV.A.2.3.2 Conformance with Colorado State Regulations

The CSOC diesel generators are subject to the regulations of the State of Colorado Air Quality Control Commission. Under the Commission's regulations, units which are less than 1000 hp are exempt from the agency's permit requirements. Since the CSOC units are equal to 1000 hp, an application may be required to operate the generators.

When operating, the diesel generators must meet the following State emission regulations.

State Regulation	Emission Standard	Maximum Emission Rate/ Generator, Based on State/Local Regulations*
1.IA.1	20% Opacity	
1.IIA.1	$P = H^{-0.26}$ (P = Particulate maximum emission rate, lbs/million Btu/hr H = generator heat input, million Btu/hr)	32.5 lbs/hour
1.IIIA.4.b	$S = .8 \times H$ (S = Sulfur dioxide maximum emissions rate, lbs/hr H = generator heat input, million Btu/hr)	90 lbs/hour

The estimated CSOC generator emissions of 26 lbs/hr of particulates and 24.2 lbs/hr of sulfur dioxide indicate that the CSOC diesel generators would not exceed the above-referenced State emission standards. Furthermore, the 20% opacity standard is not likely to be exceeded based on the type of fuel oil (No. 2) to be used.

IV.A.2.3.3 Conformance with New Mexico State Regulations

The Albuquerque-Bernalillo County Air Quality Control Board has adopted regulations for fuel burning equipment which would apply to the emissions from the diesel generators. These regulations have been approved by the State of New Mexico, and are as follows:

*Based on 112 million Btu/hr heat input per turbine

Albuquerque-Bernalillo Board Regulations	Emission Standard	Maximum Emission Rate/ Generator, Based on State/Local Regulations*
Section 15.01	Nitrogen oxides emissions are limited to 0.3 lbs/million Btu heat input for units which operate an equivalent of 1×10^{12} Btu/yr heat input or greater	33.6 lbs/hour
Section 16.0	20% Opacity	
Section 16.0	Particulate emissions are limited to .03 lbs/million Btu heat input for units over 250 million Btu/hr heat input	3.4 lbs/hour
Section 17.01	Sulfur dioxide emissions are limited to .34 lbs/million Btu heat input for units which operate an equivalent of 1×10^{12} Btu/yr heat input or greater	38.1 lbs/hour

The operation of the CSOC diesel generators are exempt from the above regulations due to the small size of each diesel generator (i.e., 112 million Btu/hour heat input) compared to that specified under the regulations (1×10^{12} Btu/year or 250 million Btu/hour heat input). Hence, no state or local emission standards for nitrogen oxides, sulfur dioxide or particulates apply to the operation of the CSOC diesel generators.

IV.A.2.3.4 Conformance with Montana State Regulations

The State of Montana Air Quality Bureau has the following regulations and standards with respect to diesel generator exhaust.

State Regulation	Emission Standard	Maximum Emission Rate/ Generator, Based on State/Local Regulations*
16-2.14(1)-(S1460)	20% Opacity	
16-2.14(1)-(S1450)	Particulate emissions are limited to .35 lbs/million Btu heat input based on interpolation of emission rate curve	39.2 lbs/hour
16-2.14(1)-(S1460)	$S = 2.0 \times H$ (S = Sulfur dioxide maximum emission rate, lbs/hr H = generator heat input, million Btu/hr)	224 lbs/hour

The estimated particulate and sulfur dioxide emissions for the CSOC diesel generators are 26.0 lbs/hour and 24.2 lbs/hour respectively, and therefore do not exceed the abovementioned State emissions standards for these pollutant categories. The 20% opacity standard is complied with through the use of No. 2 fuel oil.

*Based on 112 million Btu/hr heat input per turbine

IV.A.2.4 Hot Water and Space Heating Steam Boilers

The steam boilers (two @ 175 hp each) proposed as part of the hot water and space heating system will meet any applicable state emissions standards due to their small boiler size and type of fuel (gas or diesel fuel oil) specified to be used. This is true at each of the candidate locations.

No federal EPA emissions standards will of their small size and low emission rate.

IV.A.2.5 Construction Operations Emissions

The construction phase of the project will include two sources of air pollution emissions. These are exhaust emissions from construction and grading equipment and dust from earth movement and equipment traffic on unpaved roads. The dust emissions may cause a nuisance to any persons who reside in the vicinity of the project. However, this impact will be of short duration and will occur only sporadically over the estimated two month grading phase. The dust emissions could average up to 80 lbs/acre/day of grading activity; this figure is based on EPA measurements of dust from typical grading operations. Since no site grading plan is available at this time, the total daily dust emissions cannot be exactly determined. Under the assumption that 10 acres is to be graded in any one day, the dust emissions could reach 800 lbs/day. Proper ground watering procedures should be implemented as well as complying with the local dust control and grading ordinances.

In addition to the dust generated by grading activities, the routine use of unpaved roads for delivery of construction equipment/materials (this would be specifically applicable to Enoch Road at the Peterson AFB/Colorado Springs location) will also generate dust. Since Enoch Road is to be paved anyway, it is advisable to pave this road prior to construction activities, or use some other dust palliative measures.

The operation of heavy equipment will generate vehicular exhaust emissions during the construction period. These exhaust emissions are anticipated to be minimal and will cease upon completion of the CSOC. Assuming 100 gallons of diesel fuel is consumed per day during the two-month site preparation (grading) when construction vehicle emissions will be at a maximum, the emissions associated would be approximately that shown below:

Carbon Monoxide	94 lbs/day	239 lbs/day
Hydrocarbons	35 lbs/day	
Nitrogen Oxides	49 lbs/day	
Sulfur Oxides	31 lbs/day	
Particulates	30 lbs/day	

The above emissions are based on emission factors included in Table 3.2.7-1, Compilation of Air Pollutant Emission Factors, AP-42, 2nd Ediction, February 1976.

IV.A.3 Utility Impacts

Both the CSOC facility and residential households occupied by the CSOC employees and their families, would require utilities. Table 27 on the following page contains a list of the estimated quantity of water, natural gas and electricity required, and the projected wastewater treatment capacity needed for the CSOC and its population. These figures are based on 24-hour continuous

operation of the CSOC, addition of 6,100 persons to the existing population at all of the candidate locations, and distribution of the CSOC population throughout the respective urbanized area at the three locations.

Table 27

Utility Demands of CSOC Personnel and CSOC Households

Utility	Demand Factor	Total Demand
Water		
CSOC Facility	-----	82,500 gpd
CSOC Households	110 gpd/person	660,000 gpd
Wastewater Treatment		
CSOC Facility	-----	82,500 gpd
CSOC Households	110 gpd/person	660,000 gpd
Natural Gas		
CSOC Facility	------	63 MCF/yr
CSOC Households	20,000 CF/DU/month	456 MCF/yr
Electrical Power		
CSOC Facility	------	10,500 kW Peak Demand 87 MkW-Hrs/Year
CSOC Households	5 kW/DU/month	114,000 kW/yr

IV.A.3.1 Water

IV.A.3.1.1 Peterson AFB/Colorado Springs Location

The CSOC facility will have several alternatives with respect to water supply. Both the Cherokee Water District and the Pikes Peak Water Company have sufficient water to meet the CSOC need of 82,500 gallons per day. However, a water line would have to be installed from the closest point of connection (2 or 3 miles depending on which source is selected). Other water suppliers are available in the area, but they are further removed from the CSOC location and would engender added costs with no real advantage in terms of supply or improved water quality.

With the completion of several water supply sources that are presently being developed, Colorado Springs will be able to serve a population of between 500,000 and 550,000 by 1990. The Fryingpan-Arkansas water project will provide an additional 12,900 acre-feet of potable water by 1985 for serving up to 48,000 more people. The CSOC population of 6,000 persons by 1986 will use less than 13% of this new supply. Because of the timely development of the Fryingpan-Arkansas Project and others which will follow, the CSOC population can be accommodated in the region without generating a negative impact on water supply systems and capacities.

IV.A.3.1.2 Kirtland AFB/Albuquerque Location

The main portion of the CSOC facility will be housed at the Manzano Area where utilities are presently available. A new water line may be needed to replace about 2,500 feet of old line connecting the Manzano Area to the water main located in Pennsylvania Avenue. The antenna field requires only a small amount of water which can be provided by a 500-gallon storage tank placed on-site. An alternative to the storage tank is to extend the water line from the Manzano Area to the antenna field, a distance of 2.5 miles. The Manzano Area water system has capacity for delivering up to 1 million gallons per day, which far exceeds the CSOC demand for 82,500 gpd.

The Albuquerque area is endowed with water resources for the foreseeable future and by 2020 they should have enough water to support a population almost double that of today. The present water supply is sufficient to support 540,000 persons. This means that about 240,000 additional people could be served without any additional water resources. The CSOC population of 6,000 persons represents 2.5% of the 240,000 reserve.

IV.A.3.1.3 Malmstrom AFB/Great Falls Location

The base water supply is presently limited to 2.3 mgd which is nearly double the present base consumption of 1.2 mgd. The CSOC facility would use about .083 mgd. Additional water is available to the base but would require replacement of the existing base water main with a larger capacity line. Option A will require installation of a 4-inch diameter line to the nearest point of connection on-base, which is about 1800 feet from the CSOC. Water is already available at the antenna field and is adequate for Option A (i.e., the antenna field only), but not for Option B where additional water would be needed for fire protection.

Great Falls has a water supply sufficient to support a population up to 10 times its present level. Thus, water supply for the CSOC population is more than adequate.

IV.A.3.2 Wastewater Treatment

IV.A.3.2.1 Peterson AFB/Colorado Springs Location

Wastewater at the CSOC is to be treated using an on-site sewage treatment plant of the extended aeration activated sludge process design. The plant will provide screening and grinding, aeration, final clarification, and disinfection. Sludge drying beds will be provided for periodic blowdown of excess solids. Aeration blowers and chlorination equipment will be housed in an enclosure for protection. Critical plant equipment will be tied into the backup power system to allow continued operation in the event of a commercial power outage. Effluent disposal will be via lined evaporative ponds with reuse of the treated water for supplemental fire protection and irrigation. A minimum of two evaporative ponds will be used for cycling and resting of the ponds. These ponds will be lined to prevent discharge to the underground water table. In order to prevent freezing during winter months, the entire treatment system will be covered and treated water will be kept in motion.

Prior to construction of the CSOC sewage treatment plant, the Areawide Water Quality Management Plan for El Paso and Teller Counties will have to be amended through the public hearing process, to include the CSOC treatment plant. Application for the required permits cannot be obtained until the aforementioned plan has been amended to include the CSOC plant.

The regional treatment facilities for the Colorado Springs area are in the process of being expanded to accommodate future long-term growth (judged to reach 550,000 persons by the year 2020). The present treatment capacity is 42 mgd; however, wastewater generation has averaged only 24-26 mgd for the past several years. Using the current population figure of 231,000 persons, it can be determined that the wastewater generation factor is about 113 gpd per person. The CSOC will add another .66 mgd in 1985. At the present sewage generation rate (113 gpd per person) the existing treatment plant could accommodate 141,000 more persons in the area; the CSOC population of 6,000 represents only 4+% of this number.

IV.A.3.2.2 <u>Kirtland AFB/Albuquerque Location</u>

Wastewater treatment will be handled in the same manner at the CSOC facility as described for the Peterson AFB/Colorado Springs location.

Albuquerque is in the initial stages of sewage plant expansion to provide a treatment capacity of 59 mgd by 1983; this will serve a population of about 500,000, or 100,000 more than presently in the area. By 1990 the additional plant expansion will accommodate a total population of 644,000. The CSOC population of 6,000 is well within the treatment capacity level that will be on-line by 1985 when the majority of the CSOC population will be located in the area.

IV.A.3.2.3 <u>Malmstrom AFB/Great Falls Location</u>

By October 1982 the base sewage trunk line will be connected to the city's sewer system for treatment at the Great Falls regional treatment plant. This plant can treat up to 20 mgd and with the base sewage added, it will be handling only about 50% of its treatment capacity. The addition of .083 mgd from the CSOC facility and .66 mgd from the CSOC population are of minor impact on the capacity of the plant. Sewer lines will have to be installed on-base, however, to connect the CSOC facility to the base trunk line. In both Options A and B a 4-inch vitrified clay pipe sewer line would have to be installed for a distance of about 2 miles.

IV.A.3.3 <u>Natural Gas</u>

IV.A.3.3.1 <u>Peterson AFB/Colorado Springs Location</u>

The CSOC facility requires about 63 MCF per year of natural gas for heating and humidification and provision of domestic hot water. Peak demand during the winter months is estimated at 104,500 cubic feet in any 24-hour period. There are no natural gas transmission facilities in the immediate area and thus gas line extensions would be required from either the city's line 13 miles west of the site, or from People's Natural Gas line 6.5 miles to the southwest. Both of these are retailers that obtain their gas supply from Colorado Interstate Gas; both have sufficient allocations

and transmission capacities to meet the needs of the CSOC. However, the CSOC facility is not located within an already certified service area. The State Public Utilities Commission must certify additional area to be serviced by either one of the purveyors mentioned previously.

Residents residing in the Colorado Springs area presently consume just under 21 MCF per day of natural gas; during the winter months, peak consumption is about 70 MCF per day. Gas allocations from the wholesale supplier, Colorado Interstate Gas, are based on 'peak' demand, which means that Colorado Springs is presently utilizing only 39% of its allocated 180 MCF on a daily basis. The CSOC population will add a maximum of 1.25 MCF per day consumption.

IV.A.3.3.2 Kirtland AFB/Albuquerque Location

The Manzano Area is not presently supplied with natural gas; the base itself, however, has adequate capacity to serve the CSOC demands for 63 MCF per year. A high-pressure line will have to be installed from the Manzano Area to the closest point of connection with the main base line, which is in Pennsylvania Avenue 4 miles to the northwest.

Natural gas allocations to the Albuquerque area are sufficient for projected needs over the next 20 years. The estimated needs of the CSOC population can easily be fulfilled.

IV.A.3.3.3 Malmstrom AFB/Great Falls Location

By the Fall of 1984 Malmstrom AFB should have its new coal-fired heating plant in operation and available to the CSOC facility as an alternate energy source to replace or supplement heating with natural gas. In order to tap off of the present gas line at the base, a 3-mile line would have to be installed between the SAGE area (for Option A) and the line, and in Option B a 2-mile line would be required.

The Great Falls Gas Company states that their present gas supply situation is adequate; however, the continuation of Canadian gas becomes uncertain after 1985 and contingency plans should be considered for meeting a possible shortage of this resource in the future.

IV.A.3.4 Electrical Power

IV.A.3.4.1 Peterson AFB/Colorado Springs Location

Electrical power can be supplied to the CSOC facility by the Mountain View Electric Association, Inc., using one or two overhead transmission lines that will be available at the time the CSOC facility is being constructed. A 115,000-volt line is presently within 5 miles of the site; a second 69,000-volt line will soon be installed within 6 miles of the CSOC. Either transmission line will be able to provide sufficient power to meet the peak demand (10,500 kw) and annual demand (87 MkW-hours) of the CSOC.

Colorado Springs is presently supplied with a power generating capacity of 500 MW serving an area-wide population of 250,000 persons. Additional generating capacity will be added in 1988 to provide a minimum of 900 MW power in the summer and potentially 1135 MW in the winter. This amount of power is sufficient for an additional 76,000 persons; the CSOC population of 6,100 represents about 8% of this added population.

IV.A.3.4.2 Kirtland AFB/Albuquerque Location

To meet the electrical power demand of the CSOC facility, a substation will have to be built at the Manzano Area and overhead transmission lines extended about 1.5 miles. The electrical power presently available at the Manzano Area is not adequate to meet the CSOC requirements. A small transformer will be placed at the antenna field and transmission lines will be extended 1 mile from Lovelace Road to the antennas.

Electrical power is available for any foreseeable population increase in New Mexico and thus is not a problem for the CSOC population. By 1982 the Public Service Company of New Mexico will be producing 82% of its electricity from coal; it has been estimated that there is sufficient coal in the state's coal fields (at the four corners area in the northwestern part of the state) to serve the entire state for the next 500 years. New Mexico will probably start marketing its surplus capacity to other states that are running short of power generating capabilities.

IV.A.3.4.3 Malmstrom AFB/Great Falls Location

Power generating capacity from the many hydroelectric dams in the Great Falls region is more than adequate for any foreseeable population increase or added industrial needs.

Added power capacity would be needed at the base for the CSOC facility and the Montana Power Company would provide this by installing an additional 1.5 mile section of overhead transmission line to one of two existing base substations. As part of the Option A CSOC construction program, 4000 feet of transmission line would be built to the SAGE area and another 1.5 miles of line from the antenna field to the base substation. In Option B only 1.5 miles of line would be needed from the base substation.

IV.A.4 Impact on Archaeological/Historical Resources

With the exception of the Alternate 1 location at Kirtland AFB, archaeological/historical resources are not expected to be found. In the case of Kirtland AFB, there are several identified historical sites in the vicinity of the antenna field. Most of these sites can be avoided because they are on the opposite side of Coyote Springs Road where no construction activity is to take place. Site No. 4, however, is in the general locale of the antenna field and could be impacted by the access road unless care is taken to route around the site. At all three candidate locations, if any archaeological or historical finds are made during the grading operations, the State Historic Preservation Officer should be notified and an opportunity provided for evaluation of the site by a qualified archaeologist.

IV.A.5 Short-Term Construction Impacts

The CSOC facility will require approximately two years to build; construction is planned to start in April 1982 and be completed by April 1984. The peak construction activity will occur mid-way in April 1983; a maximum of 350 temporary construction workers could be employed at this period. For purposes of determining the potential magnitude of impacts directly related to construction, it will be assumed that all of the workers will come from other areas and will live temporarily in the area without their families. In reality, it is likely that a substantial percentage of the jobs can be filled from the local labor market.

If a significant number of construction workers are brought in from outside the area, the prime contractor will be responsible for providing temporary housing at the CSOC site. Mobile units (trailers) will be used for sleeping quarters and food preparation/serving facilities. If water is not available by the time the construction village is established, a storage tank for potable water will be placed on-site. Other utilities such as power and sewage treatment will be provided for by either prior installation of these services or in the alternative, by generators for power and chemical toilets with holding facilities that are periodically pumped for treatment of sewage off-site.

The following sections describe construction impacts that are unique to each of the candidate locations.

IV.A.5.1 Peterson AFB/Colorado Springs Location

Unlike the two alternate locations, construction of the CSOC at the preferred location will impact other privately-owned property and in some cases public roads and highways. This is a direct result of the need to extend utilities a considerable distance and the fact that CSOC is not located on the base. Short-term construction impacts are generated by the following:

1. Grading of CSOC site to accommodate building pads, antennas, sewage lagoons, a 2700-foot access road (8000 feet if Section 24 is selected) 24 feet wide, a 10-foot wide perimeter patrol road around the CSOC fenced area, and a 10-acre parking lot.

2. Construction of CSOC structures and installation of 5 radome antennas.

3. Paving 2.5 miles of Enoch Road from Highway 94 to the CSOC access road.

4. Paving the 10-foot wide perimeter patrol road and 10-acre parking lot.

5. Improvement of Highway 94 at the intersection with Enoch Road, consisting of widening and paving of roadbed and striping. (This may be performed by the State Highway Department.)

6. Off-site trenching for installation of underground utilities in public highway rights-of-way and potentially across private property. Estimated distances and approximate routes are:

   a. Water . . . 2-3 miles of pipe in Enoch Road

   b. Gas . . . . 6 or 13 miles depending on purveyor selected

   c. Power . . . 5 miles, or 11 miles if two overhead transmission lines are used.

If Section 26 is selected, only nominal grading would be necessary to create the building pads and parking lot and provide proper surface drainage. Section 24 would require greater cuts and fills for the 10-acre parking lot. On Section 26 the perimeter patrol road would have to cross a natural drainage course at two different points; it might be necessary to provide a bridge over these courses in order to maintain a passable road year-round. Both sites would be graded to avoid import or export of dirt. If at a later date additional floor space is required and the CSOC is constructed on Section 24, considerable landform alteration would be needed to accommodate additional buildings. Over the maximum two-month period estimated for the grading phase, dust control measures should be used in accordance with the county's dust control regulations. These regulations call for the entrapment of 50% of the dust emissions which requires that the surface be kept moderately wet. This would apply to unpaved roads in the area as well since construction traffic would stir up dust clouds. On extremely windy days when dust containment cannot be accomplished, grading activities may have to be temporarily stopped.

Construction traffic would use Highway 94 and Enoch Road for deliveries during the 24-month construction period. Dust generation on Enoch Road could be eliminated almost entirely by either paving the road prior to construction or wetting the surface, or applying some other dust palliative such as oil.

Extension of utilities could be disruptive to traffic on public roads and highways where underground lines are being installed in the right-of-ways. Highway improvements on Highway 94 near the Enoch Road intersection will disrupt traffic on a short-term basis and this would be most noticeable to those residents who live on Enoch Road.

Construction noise should not be significant due to the distance of 1500 feet separating the CSOC site from the nearest farmhouses.

IV.A.5.2 Kirtland AFB/Albuquerque Location

Since the entire CSOC facility is located on base, construction impacts would be confined with one exception, to the base. This exception is the transport of construction equipment and supplies which could interfere with traffic flow during the peak base hours. Other short-term construction impacts are:

1. Construction of Technical and Powerplant buildings, and substation at the Manzano Area; construction of a guardhouse at the antenna field.
2. Grading for antenna pads, sewage lagoons, and perimeter patrol road.
3. Trenching for:
   a. 12,800 feet for fiber optics or co-axial cable
   b. 2.5 miles of water line from Manzano Area to antenna field
   c. 4 miles of gas line from Manzano Area to Pennsylvania Avenue
4. Installation of 2.5 miles of overhead power transmission line from Manzano Area and antenna field to existing lines in Pennsylvania Avenue and Lovelace Road, respectively.
5. Road improvements consisting of:
   a. Paving 1000 feet of dirt road at the Manzano Area
   b. Paving 700 feet of dirt road connecting Coyote Springs Road to the antenna field
   c. Paving 1 mile of Coyote Springs Road
   d. Paving of 10-foot wide perimeter patrol road

Short-term impacts associated with the above projects result primarily from construction traffic and dust. The nominal grading that is required for the antenna field will not generate any import or export of dirt. Conflicts with base traffic could occur due to construction traffic, particularly during the peak hours in the morning and evening. Dust would be generated unless dirt areas being graded or used by vehicular traffic are paved or otherwise covered to prevent dust. Base traffic would not be impacted by the extension of utility lines except where the data transmission cable and water line cross Pennsylvania Avenue and Coyote Springs Road. This impact would be minor since there is very little traffic in this area.

IV.A.5.3 Malmstrom AFB/Great Falls Location

Short-term construction activities vary depending on whether Option A or B is selected.

Option A

1. Demolition of 10 existing buildings
2. Re-routing of sections of base roads in the vicinity of the SAGE building.
3. Construction of Technical Building, Powerplant, two guardhouses, and installation of 5 radome antennas.
4. Grading for building pads, antenna pads, a 10-acre parking lot, .5 mile of access road to the antenna field, perimeter patrol road at the antenna field.
5. Trenching for:
   a. 8,700 feet of fiber-optics or coax cable
   b. 1,800 feet of water line
   c. 3 miles of gas line
   d. 2 miles of sewer transmission line
6. Paving 3 miles of road connecting the CSOC buildings with the antenna field, the perimeter patrol road surrounding both the CSOC buildings and the antenna field, and .5 mile of access road at the antenna field.
7. Install 1.75 miles of overhead power transmission line on base property.

Option B

1. Construction of entire CSOC structures and installation of 5 radome antennas, 1 guardhouse, and 1 new base entry gate at U.S. 87/89.
2. Grading for building and antenna pads, perimeter patrol road, a 10-acre parking lot.
3. Trenching for:
   a. 3 miles of water line
   b. 2 miles of gas line
   c. 2 miles of sewer transmission line
4. Paving of perimeter patrol road at one location only, 3 miles of existing base road connecting to main base area, 1600 feet of access roads connecting to U.S. 87/89.

Construction-related traffic (deliveries) could add to the congestion at the 2nd Avenue North entry gate in the Option A configuration. Under Option B deliveries could be routed through the south entrance off of U.S. 87/89.

All utility extensions are to occur on-base where traffic can be rerouted for short periods. Grading for Option A will be minimal except at the antenna field where level pads will have to be created for each antenna. In Option B, grading is more extensive because the entire facility is to be located on a previously ungraded site. The parking lot in Option B is estimated to require cuts/fills up to 10 feet in depth. Dust control should be maintained by surface wetting or other dust palliative measures, or by paving roads to be used during construction.

IV.A.6 Visual Impacts

The CSOC facility is not visible from public highways and roads at the Kirtland AFB location. Visibility from nearby roads and occupied dwellings at the Colorado Springs and Malmstrom AFB location are discussed below.

IV.A.6.1 Peterson AFB/Colorado Springs Location

The CSOC facility will be visible from Highway 94 and from Enoch Road and occupied farmhouses on Enoch Road. Travelling east on Highway 94 the CSOC antennas first become visible at the Corral Bluffs summit just west of Blaney Road and are seen from the highway for the next mile or so. Intervening topography blocks out the view of the antenna for about 3 miles as indicated by the shaded area on Figure 16. The antennas are once again visible from the highway for about a two mile stretch. Even though the antennas can be seen from the highway, the visual impact is less significant due to the 2 to 4 miles between the viewer and the antennas.

The entire antenna field and CSOC buildings will be visible from Enoch Road and from farmhouses located on Enoch Road. This view could be somewhat obscured by landscape materials planted along the south and west property lines of Section 26. A panorama of Section 26 looking eastward is in Figure 17; the white areas on the ground are snow. Enoch Road is on the right side of the photograph.

IV.A.6.2 Malmstrom AFB/Great Falls Location

The antenna field will be visible from U.S. 87/89 for quite some distance particularly in the stretch of highway southeast of the base. Drivers proceeding east on U.S. 87/89 from downtown Great Falls will be able to see portions of the antenna radomes until they pass 52nd Street. For the next one mile or so, a hill on the north side of the highway serves to block the view of the CSOC area. Beyond this point the antennas are visible to varying degrees, but since the distance from the field increases as you travel east on 87/89, the radomes become progressively smaller in appearance. The planting of trees along the north side of U.S. 87/89 would help to obscure the view of the radomes; however, the base boundary does not extend to the highway in that portion where landscape materials could be effective.

From 52nd Street portions of the antennas are visible for a half-mile stretch between 3rd Avenue South and U.S. 87/89. The shaded areas in Figure 18 identify those sectors where the tallest antenna cannot be seen from the nearby highways.

A panorama of the Option B CSOC site is presented in Figure 19. This photograph was taken from the south property line spanning from the west to east borders of the site.

IV.A.7 Electromagnetic Radiation Impacts

The subject of electromagnetic radiation (EMR) hazard has been receiving increased public attention. This is particularly the case when radiation extends to property outside the controlled facility boundaries. The communication antennas associated with the CSOC facility produce ground level power densities (both inside and outside the fenced CSOC area) that are considerably below those considered hazardous on the basis of current state-of-

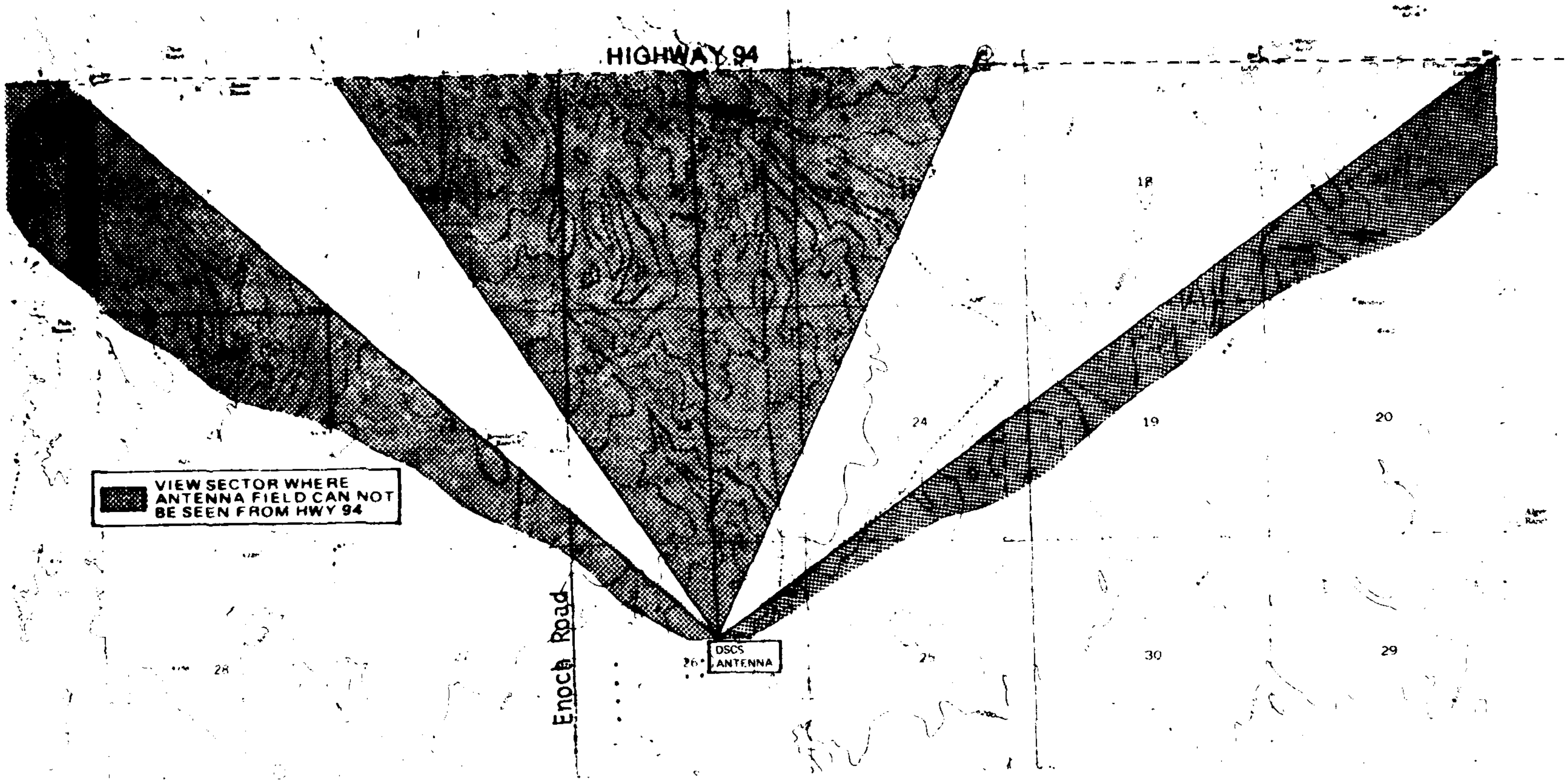

Figure 16 View Sectors of Antenna Field Seen from Highway 94 (Peterson AFB/Colorado Springs Location)

Figure 17 Panoramic Photograph of Section 26 at Colorado Springs Location

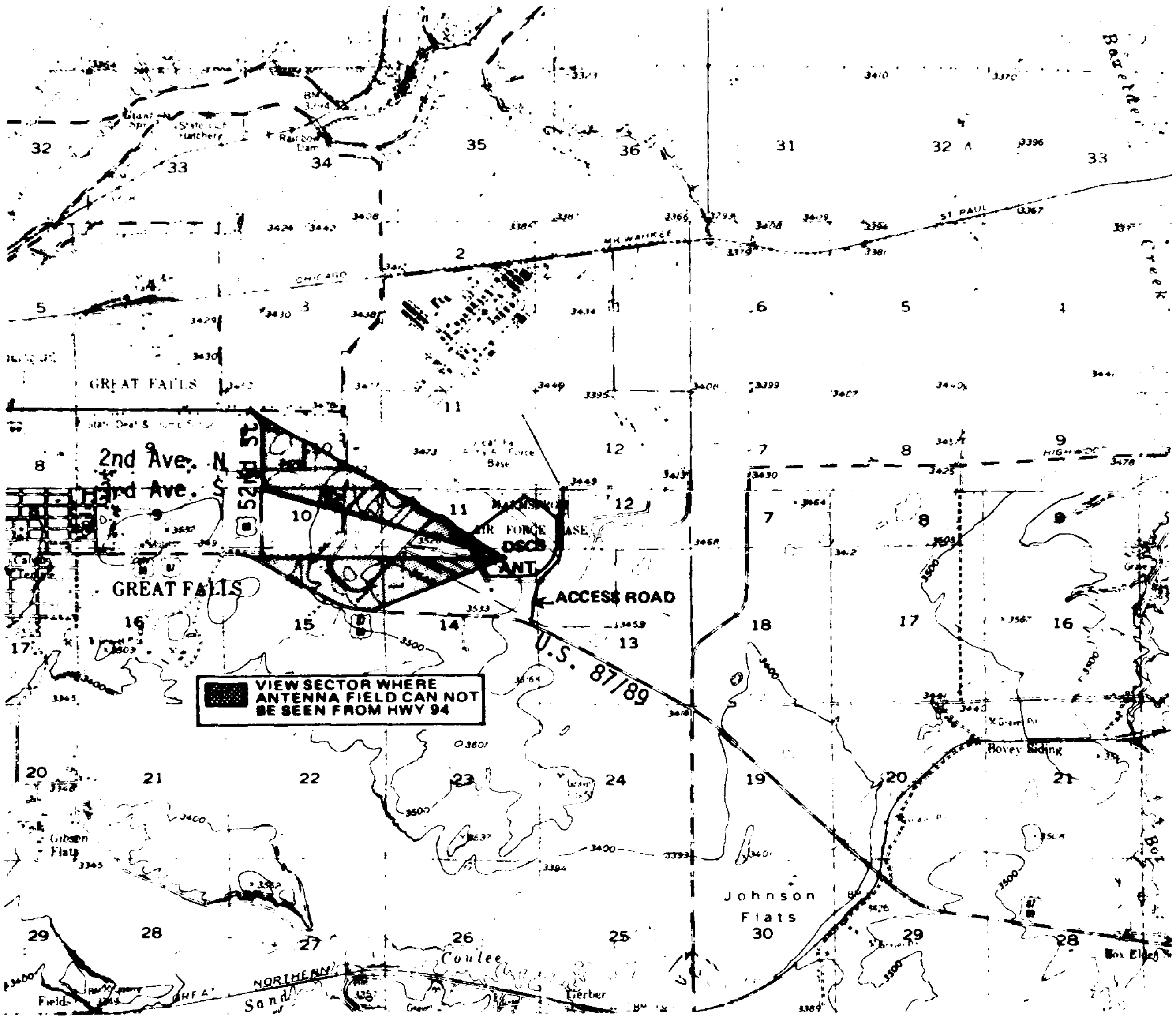

Figure 18 View Sectors of Antenna Field Seen from U.S. 87/89 and 52nd Street (Malmstrom AFB/Great Falls Location)

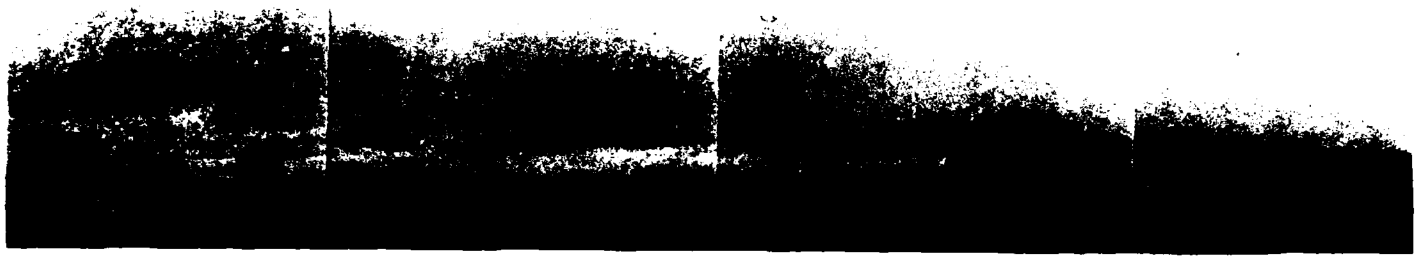

Figure 19 Panoramic Photograph of Antenna Field at Malmstrom AFB

knowledge. However, under certain operating conditions the CSOC antennas can produce hazardous power densities in the main beam in an air-borne environment. A complete analysis has been made of the theoretical power density levels for each antenna by itself, and for the 'worst case combinations' of antennas. This section provides a summary of the permissible non-ionizing radiation criteria, and the power density levels generated by each CSOC antenna. An explanation of the methods used in calculating the on-axis and off-axis (ground level) power densities is included in Appendix A.

IV.A.7.1 Power Density Criteria and Standards

Table 28 presents the maximum permissible power density criteria in use in the United States at the present time, for three areas of concern: Personnel, Fuel Storage and Handling, and Electroexplosive Devices (EEDs).

Table 28

Maximum Permissible Power Density Criteria

Antenna Type	Criteria by Category - mw/cm^2				
	1-6-7-8	2	3	4	5
DSCS	10	5000	10	10	1000
DOMSAT	10	5000	10	10	1000
DLT	10	5000	1.46	10	146
SCS	10	5000	10	10	1000
S-Band	10	5000	1.34	10	134
TDRSS	10	5000	10	10	1000

Category Definition:

Category 1 . . . Personnel Maximum Permissible Exposure Level (MPEL)
Category 2 . . . Safe Limit for Fuel Handling
Category 3 . . . Exposed EEDs on the ground
Category 4 . . . EEDs stored/transported (on the ground) in non-metallic containers
Category 5 . . . EEDs carried externally on taxiing aircraft and unarmed
Category 6 . . . EEDs stored/transported on the ground in metallic containers
Category 7 . . . EEDs carried externally on aircraft in flight
Category 8 . . . EEDs packaged and transported on aircraft in flight

NOTE: mw/cm^2 is milliwatts per square centimeter.

The Maximum Permissible Exposure Level (MPEL) for occupational personnel is 10 mw/cm^2 and is based on past knowledge of radiofrequency radiation effects (Ref. AFOSH Standard 161-9 dated 10 October 1978). The criteria for fuel storage and EEDs are listed in T.O. 31Z-10-4/Change 2 dated 1 August 1966 and 1 June 1971, and AFR 127-100/Change 1 dated 31 March 1978 and 18 June 1979.

Although the United States has used an MPEL guide of 10 mw/cm^2, the Soviet criteria for acceptable continuous occupational radiation exposure is .01 mw/cm^2 and .001 mw/cm^2 for non-occupational exposure. This wide disparity between the United States guide and Soviet standards has prompted scientific debate and further research by the United States on biological effects of radiation, with consideration towards developing new standards. While AFOSH Std. 161-9 supports the 10 mw/cm^2 level at this time, it too may be revised before the CSOC is in operation. Revisions being considered by the American National Standards Institute, the National Institute of Occupational Safety and Health, and the Environmental Protection Agency, are frequency-dependent guidelines and will lower the permissible levels by a factor of about 10 in the human resonance (worst case) region of the electromagnetic spectrum.

The USAF has a significant Radiofrequency Radiation (RFR) bioeffects research program underway which is directed toward detection and characterization of RFR-induced biological effects and to assess their clinic significance for relatively long-term low-level exposures. Since the Air Force operates many pulsed systems, special emphasis has been on pulsed or modulated fields. A second area of concern is the heat rise in the human body. The thermal effect is a complex function of several parameters and for RFR exposures it begins with energy absorption and distribution, which are both strongly frequency-dependent over the total spectrum. While no extensive long-term low-level studies have been completed, the current RFR bioeffects state-of-knowledge supports long-term safety. The possibility that new information would reveal a hazard cannot be dismissed, but is judged to be low.

Recommendations by the School of Aerospace Medicine and the Association for the Advancement of Medical Instrumentation (AAMI) to the Federal Drug Administration and other governmental regulating agencies for cardiac pacemakers state that all new pacemaker equipment should be designed and tested to be compatible with a minimum E-field level of 200 V/m, which is equivalent to 10 mw/cm^2 MPEL.

The American National Standards Institute, National Institute of Occupational Safety and Health, and the Environmental Protection Agency have recently convened to establish new MPEL standards. At the present time, the standards being considered for adoption are:

1 mw/cm^2 . . . For frequencies between 30 and 1000 MHz
1-5 mw/cm^2 . . . For frequencies between 1000 and 3000 MHz
5 mw/cm^2 . . . For frequencies greater than 3000 MHz

The CSOC antennas operate between 1784 and 30,000 MHz.

IV.A.7.2 CSOC Antenna Characteristics

The CSOC antenna design characteristics which were used for performing the theoretical calculations are tabulated in Table 29 on the following page. Initially only the DSCS, DOMSAT and DLT antennas will be installed at the CSOC; at a later date the SCS, S-Band and TDRSS antennas may be installed. Each antenna radiates at a nominal power output under normal conditions; the peak power output is for use in an extreme jamming environment or for communicating with a malfunctioning satellite. Each antenna radiates in specific directions as defined by the azimuth and elevation angles and ranges of angles listed in Table 30. Azimuth angles represent the horizontal look angle sectors as measured clockwise from True North (0°). Elevation angles represent the vertical range of look angles as measured above the horizontal (0°).

Table 29

CSOC Antenna Design Parameters

Antenna Parameters	Initial			Future		
	DSCS	DOMSAT	DLT	SCS	S-Band	TDRSS
Frequency . . . Megahertz	8400	6200	1850	30000	1784	15225
Diameter. . . Feet	60	33	51	33	33	60
Half-Power Beam Width . . . Degrees	.13	.30	.67	.06	1.04	.065
Antenna Gain, G . . . dBW	61.8	54.4	47.0	67.0	44.5	66.7
Peak Power . . . Watts	4230	75	2000	2000	2500	220
Normal Power . . . Watts	100	50	500	500	----	---
Centerline Height . . . Feet	60	33	51	33	33	60
Peak Power . . . dBW (Transmitter & Antenna)	97	98	80	108	72.9	---

The main beam contains a high percentage of the antenna's radiated power. However, radiated power is also developed in side and back lobes which may reach ground level in the vicinity of the antenna. Both the main beam and side lobe radiation power densities are considered in this analysis.

For purposes of comparison, ground level power density calculations have been made for each antenna based on the following assumptions:

- Maximum power operation
- Minimum elevation angle
- Level ground extending away from the antenna

The theoretical maximum ground level power densities are presented in Table 31. The calculations indicate that none of the antennas will produce power densities in excess of .01 mw/cm^2 and that only the DLT at 3° elevation angle and the S-Band antennas produce values above .001 mw/cm^2. In no case do ground level power densities exceed the lowest exposure standard in use anywhere in the world. (The lowest non-occupational exposure level is the Soviet standard of .001 mw/cm^2.) For the level ground case, no hazard to personnel will be encountered even in the unlikely circumstance where all antennas are positioned so as to radiate above the same point on the ground. The effect of variations in local topography is discussed in the following sections which deal with site-specific radiation hazards.

Table 30

Viewing Sectors of CSOC Antennas

Antenna Type		Peterson AFB/ Colorado Springs		Kirtland AFB/ Albuquerque		Malmstrom AFB/ Great Falls	
		True Azimuth (°)	Elevation (°)	True Azimuth (°)	Elevation (°)	True Azimuth (°)	Elevation (°)
DSCS-E	Initial	223	35.8	223	41.1	212	31.4
DSCS-W	Initial	257	5.0	260.1	5.3*	258	5.34*
DOMSAT	Initial	160 - 200	40 - 48	165 - 195	42 - 52	165 - 195	30 - 40
DOMSAT	Initial	160 - 200	40 - 48	165 - 196	42 - 52	165 - 195	30 - 40
DLT-NE	Initial	22 - 31	3 - 12	21 - 26	3 - 8	20 - 30	3 - 18
DLT-E	Initial	29 - 82	3 - 30	28 - 77	3 - 26	29 - 77	3 - 35
DLT-W	Initial	238 - 329	5 - 46	237 - 329	5 - 43	230 - 323	5 - 58
SCS-NE	Future	33 - 58	10 - 27	32 - 56	10 - 24	32 - 59	10 - 30
SCS-SE	Future	106 - 111	10 - 15	105 - 109	10 - 16	107 - 111	8 - 10
SCS-SW	Future	249 - 254	10 - 15	251 - 255	10 - 16	250 - 254	8 - 10
SCS-NW	Future	285 - 327	10 - 27	288 - 328	10 - 24	286 - 323	10 - 38
S-Band	Future	0 - 360	5 - 90	0 - 360	5 - 90	0 - 360	5 - 90
TDRSS-E	Future	---	---	109	12	---	---
TDRSS-W	Future	---	---	248	13	---	---

NOTE: TDRSS Satellites not visible from Peterson AFB/Colorado Springs and Malmstrom AFB/Great Falls locations.
*WESTPAC DSCS repositioned to 180° W Longitude (5° move)

Table 31

Maximum Level Ground Power Densities
at
Minimum Elevation and Maximum Power Operation

Antenna Type		Maximum Level Ground Power Density (mw/cm^2)	Distance from Antenna Where Beam Touches Ground (feet)
DSCS-E	Initial	.00000056	7,000
DSCS-W	Initial	.000057	7,000
DOMSAT	Initial	.00000072	2,000
DLT-NE, -E	Initial	.0012	1,600
DLT-W	Initial	.00052	1,500
SCS	Future	.00000047	5,600
S-Band	Future	.0027	700
TDRSS-E	Future	.000000118	13,000
TDRSS-W	Future	.000000097	12,000

NOTE: TDRSS data applicable to Kirtland AFB/Albuquerque location only.

There are certain inherent operational conditions which act as mitigations to reduce the impact of electromagnetic radiation. These are:

- The antennas have been designed to operate at a peak power which will enable closure of RF links to higher altitude satellites, should they be developed in the future. The power required for closure with the present satellites will routinely be accomplished at a power level which is 30 dB below the peak power used in these calculations. Therefore, under normal operation the power densities experienced will be lower than those shown by a factor of 1000.

- The typical total visibility timespans for the satellites being tracked by the S-Band antenna(s) is shown in Figure 20. Each row of 'dashes' and 'numbers' represents one satellite. The horizontal axis represents time for a 24-hour day. The dashes represent elevation angles of 10° and greater; the numbers 5 through 9 are the actual elevation angles which reflect the first and last opportunities to track a

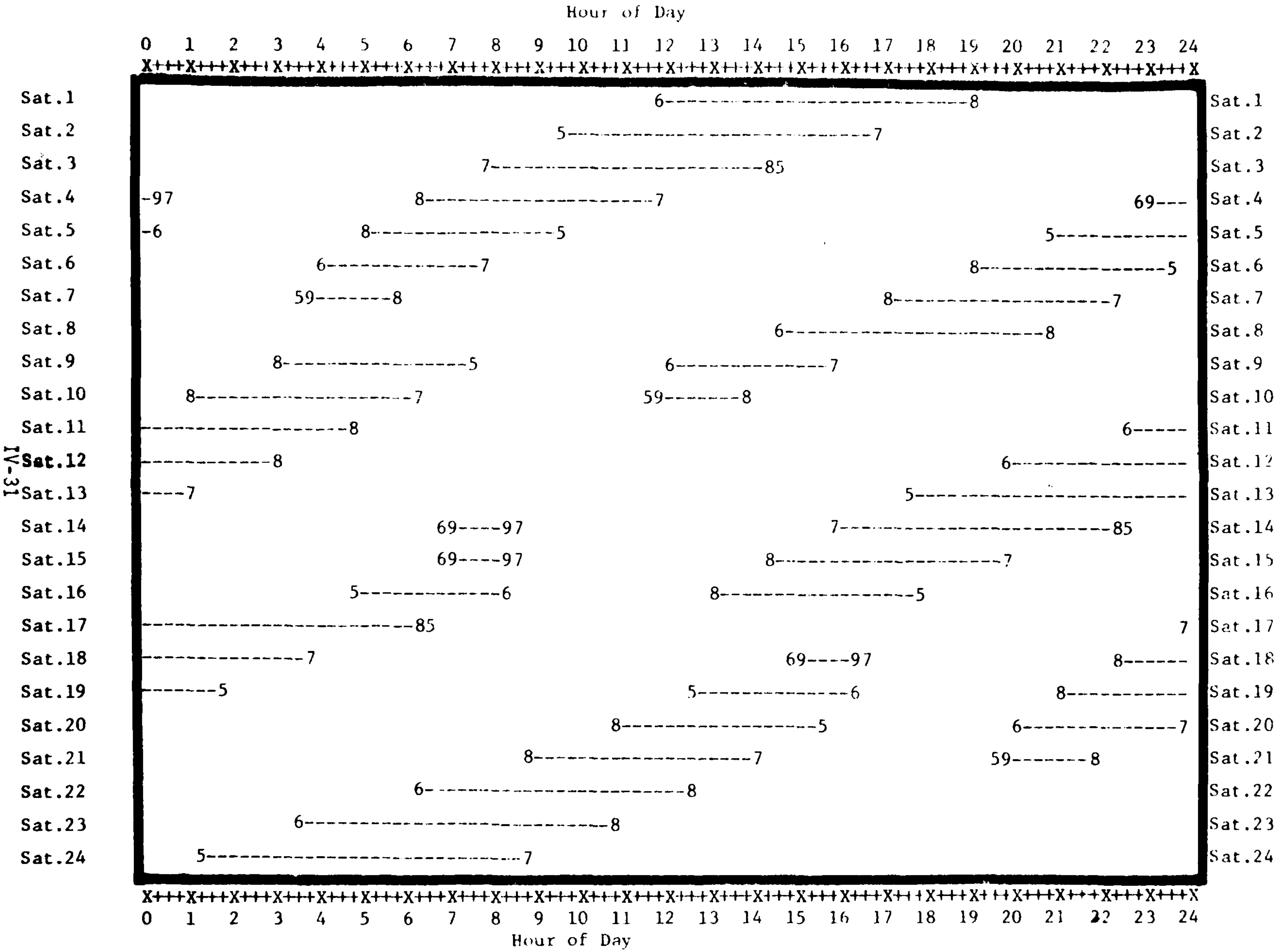

Figure 20 Satellite Viewing Times and Elevation Angles

satellite at angles between 5° and 9°. Routine satellite support will be scheduled near the center of the visibility space for each satellite, which is likely to range from 40° to 90°, depending on the satellite's orbit. The levels presented in this figure therefore are expected to occur only in the rare extreme of commanding a failing satellite at 5° just before it sets over the horizon. Based upon experience with the satellites, and considering that the reliability and lifespan are increasing, the frequency of viewing a satellite at the minimum elevation angle is estimated to occur about once every three months.

- The power densities at ground level occur at a given point for only brief period of time because of the slow but constant movement of the antenna as it tracks a satellite.

IV.A.7.3 Electromagnetic Radiation Impacts at Peterson AFB/Colorado Springs Location

The CSOC antenna field configuration proposed for the Peterson AFB/Colorado Springs location is presented in Figures 21 and 22. The azimuth view sectors are indicated by the shaded areas with the exception of the S-Band antenna which rotates in a complete circle. In evaluating the power density at given locations, the cumulative effect of all antennas that could be operated over that location has been considered.

IV.A.7.3.1 Personnel Safety

Evaluation of personnel safety involves consideration of the maximum power density at ground level which is produced by the cumulative power density from each antenna that could be focused over a given location. The following assumptions are made to provide a 'worst case' analysis:

- All antennas radiate at maximum operating power
- All antennas radiate at the minimum elevation angle
- Outside the main beam the maximum allowable gain will exist (per FCC Rules and Regulations 25.209)

As discussed in Section IV.A.7.2, the maximum level ground radiation that can be produced by any single antenna is well below the 1-5 mw/cm^2 being considered for adoption as the United States safety standards. For the level ground case (refer to Table 31), only the DLT and the S-Band antennas exceed even the .001 mw/cm^2 level. It may therefore be concluded that unless the terrain or structures are above the MSL elevation of the antenna site itself, ground level power densities will not exceed .005 mw/cm^2. This is several orders of magnitude below the 1 mw/cm^2 threshold being considered for adoption.

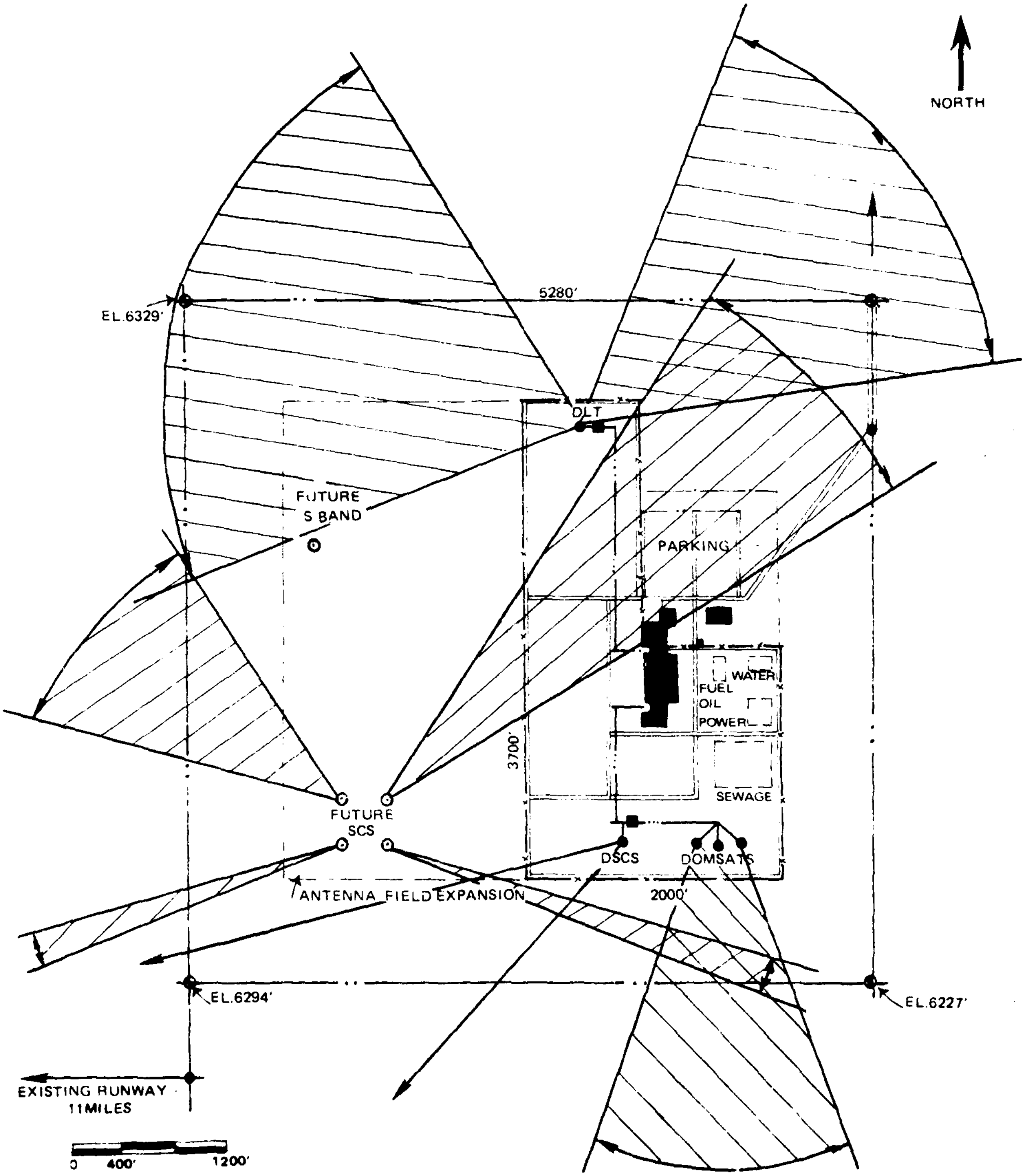

Figure 21 Antenna Layout on Section 24 at Peterson AFB/Colorado Springs Location

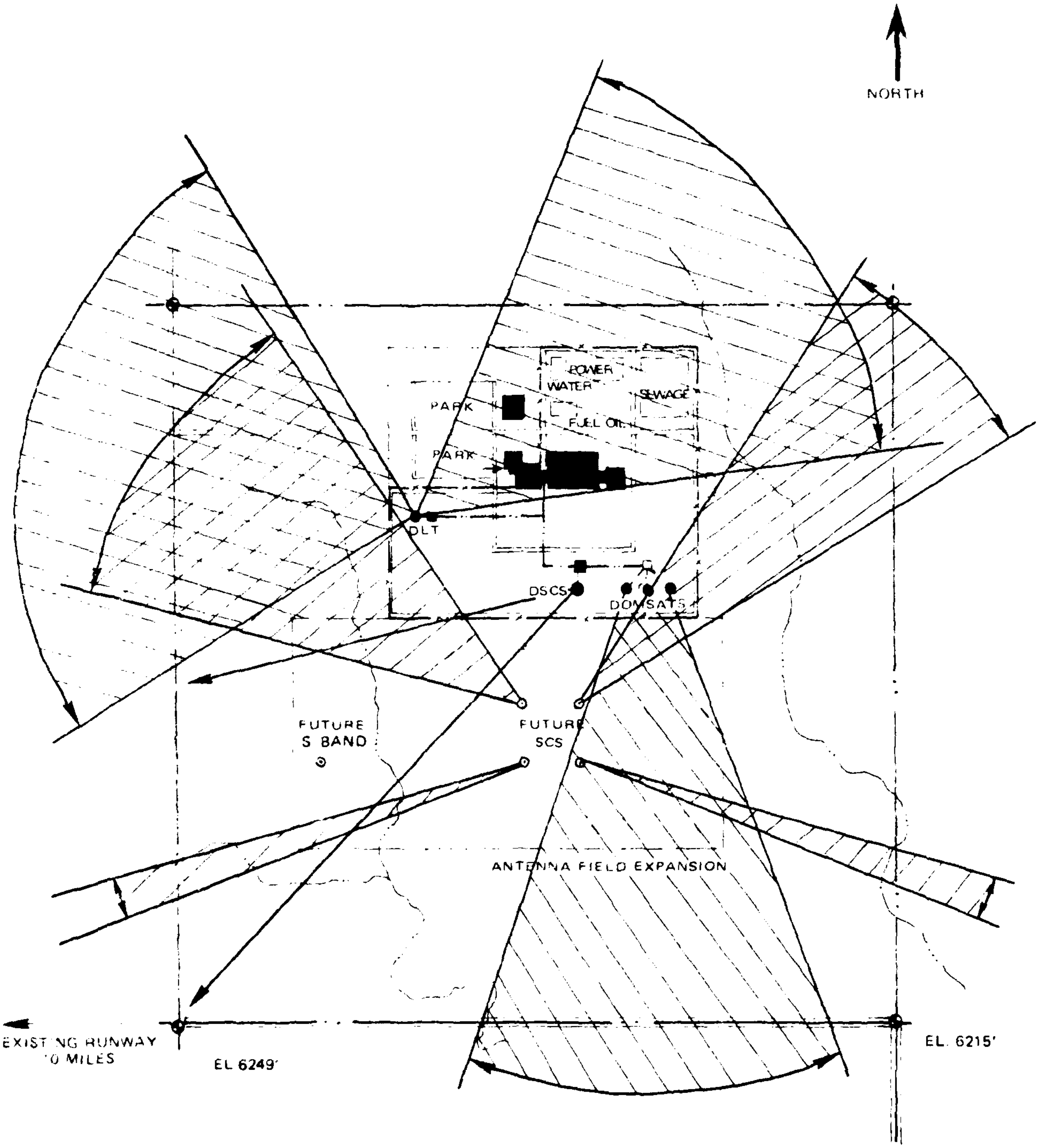

Figure 22 Antenna Layout on Section 26 at Peterson AFB/Colorado Springs Location

The terrain in the vicinity of both Sections 24 and 26 slopes downhill from the antenna field in all quadrants except the northwest sector. Because of the increasing height of the main beam above ground level, it would be impossible to identify areas where power density exceeds the .1 or the .01 mw/cm^2 levels. Only a very small area will even exceed .001 mw/cm^2. In the northwest quadrant the ground slopes uphill and radiation levels in excess of .001 mw/cm^2 could be produced by the combined radiation of the DLT, S-Band and SCS-NW antennas. For analysis of predicted power densities in this area, two situations are evaluated:

- Ground level power density along a line radiating from the antenna field in a northwest direction
- Power densities at specific locations where habitation is likely

The calculations in Tables 32 and 33 represent cumulative power densities in those cases where more than one antenna can beam over a given location (as in the case when the future SCS and S-Band antennas are considered in addition to the DLT antenna to be initially installed). The data in Table 32 shows the ground level power density along a line which begins at the northwest corner of the fenced antenna area on Section 26 and moves outward in a northwest direction. This configuration is depicted in Figure 23. Cumulative power density values are the arithmetic sum of the contribution of each antenna; this is a more conservative method than the RMS sum. It can be seen that with the future SCS and S-Band antennas the power density reaches a maximum of .0034 mw/cm^2 at the fenceline and then drops off as the distance from the antenna field increases. At about 3,000 feet the power density drops below .001 mw/cm^2.

Table 32

Maximum Ground Level Power Densities at Peterson AFB/Colorado Springs

Distance from Antenna Field Fenceline (feet)	Cumulative Ground Level Power Densities	
	Initial DLT Ant. (mw/cm^2)	With Future SCS & S-Band Ants. (mw/cm^2)
0 (Fenceline)	.00010	.0034
500	.00052	.0031
1000	.00086	.0031
2000	.00066	.0019
3000	.00044	.0010
4000	.00033	.0007
5000	.00022	.0005

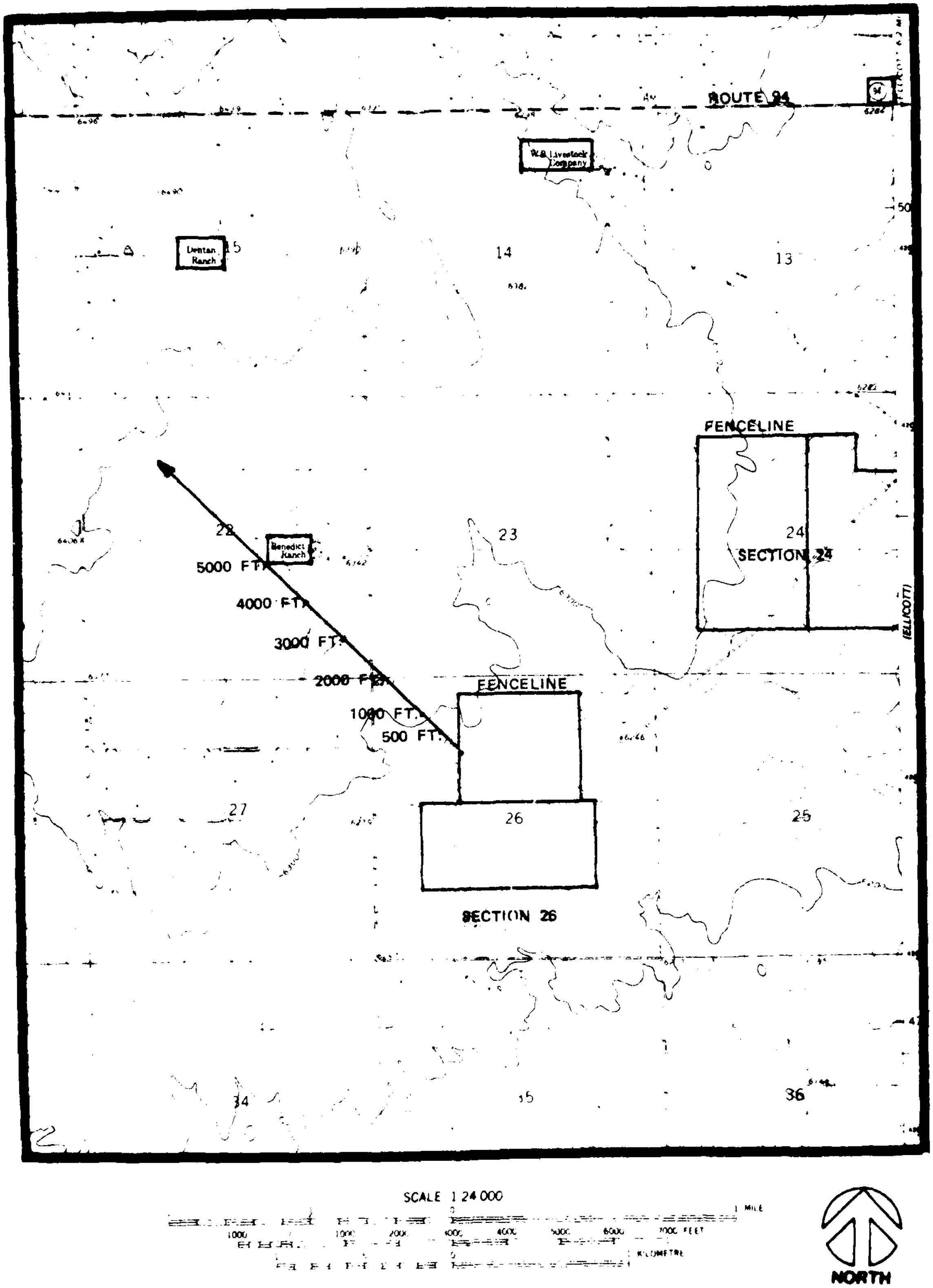

Figure 23 Specific Sites Examined for Calculated Ground Level EMR at Peterson AFB/Colorado Springs Location

Power densities at specific points of habitation (which are also identified on Figure 23) are tabulated in Table 33 below. In each case, the closest point on either Section 24 or 26 was used and the arithmetic sum of the initial and future antennas was used to assess the cumulative power densities.

Table 33

Calculated Ground Level Power Density at Specific Sites
at
Peterson AFB/Colorado Springs Location

Location	MSL Elevation (feet)	Distance from Antennas (feet)	Power Density Initial Ants. (mw/cm^2)	Power Density With Future Ants. (mw/cm^2)
Benedict Ranch	6,360	5,200	.00023	.00058
Dentan Ranch	6,440	10,000	-0-	.000096
W.B. Livestock Co.	6,230	6,280	-0-	.00014
Highway 94	6,258	7,000	.00021	.00028

Power density values which will be found on the rooftops of buildings within the CSOC facility are shown in Table 34 for the site layouts depicted In Figures 21 and 22. These calculations are based on the assumption that the Engineering and Administration and Technical Buildings will be built at the same mean sea level elevation as the DLT antenna. (Variations in actual elevations may necessitate re-calculating power densities as the site and grading plans are finalized.) The buildings evaluated in Table 34 represent the worst case as all other CSOC structures are lower or are not located within the viewing sectors of the antennas.

Table 34

Calculated Roof Level Power Densities
at
Peterson AFB/Colorado Springs Location

Section	Building	Bldg. Ht. (feet)	Antenna	Distance from Antenna (feet)	Power Density (mw/cm^2)
24	E&A Bldg.	48	SCS	2,400	.0000061
			S-Band	2,600	.018
	Tech. Bldg.	68	S-Band	2,650	.021
26	Tech. Bldg.	68	DLT	1,000	.013
			S-Band	2,200	.026

Although the power densities at rooftop level of the CSOC buildings are predictably higher than at ground level, they are well below the 1-5 mw/cm^2 level being considered for adoption as the United States MPEL criteria.

IV.A.7.3.2 Electroexplosive Device Safety

The criteria for various categories of EEDs are listed in Table 28. The most stringent criteria is that for the S-Band and DLT antennas at 1.34 and 1.46 mw/cm^2 respectively. For the antenna installation at either of the sections under consideration at Colorado Springs, no single antenna or combination of antennas is capable of producing ground level power densities that exceed this criteria.

Airborne EEDs must be restricted from any area where a power density level in excess of 10 mw/cm^2 can be reached. Table 35 lists the maximum power density which can be reached in the main beam, and the distance from the antenna to which this maximum level can extend.

Table 35

Maximum Power Densities in the Main Beam of CSOC Antennas

Antenna Type	Maximum Main Beam Power Density (mw/cm^2)	Distance from Antenna (feet)
DSCS	3.75	7,400
DOMSAT	.25	1,650
DLT	2.35	1,160
SCS	5.10	8,000
S-Band	10.06	473

The S-Band antenna is capable of exceeding the 10 mw/cm^2 criteria out to a radial distance of 473 feet. Although the CSOC facility is not within a normally traveled air corridor where aircraft would be below 473-foot altitude, precautionary measures should be taken to avoid the EED hazard which could exist within a hemispherical volume of the S-Band antenna. It is therefore recommended that aircraft be restricted from within 1000 feet of the facility.

IV.A.7.4 Electromagnetic Radiation Impacts at Kirtland AFB/Albuquerque Location

The CSOC antenna field layout at Kirtland AFB is identified in Figure 24; the view sectors of each antenna are indicated by the shaded areas. In the case of the S-Band antenna, however, the view sector is not identified since this particular antenna views over the entire 360° spectrum. Note that the TDRSS antenna is included at this location.

To the north of the CSOC facility the Manzano Mountains rise abruptly to elevations above 6400 feet MSL. In general the terrain rises to the north-

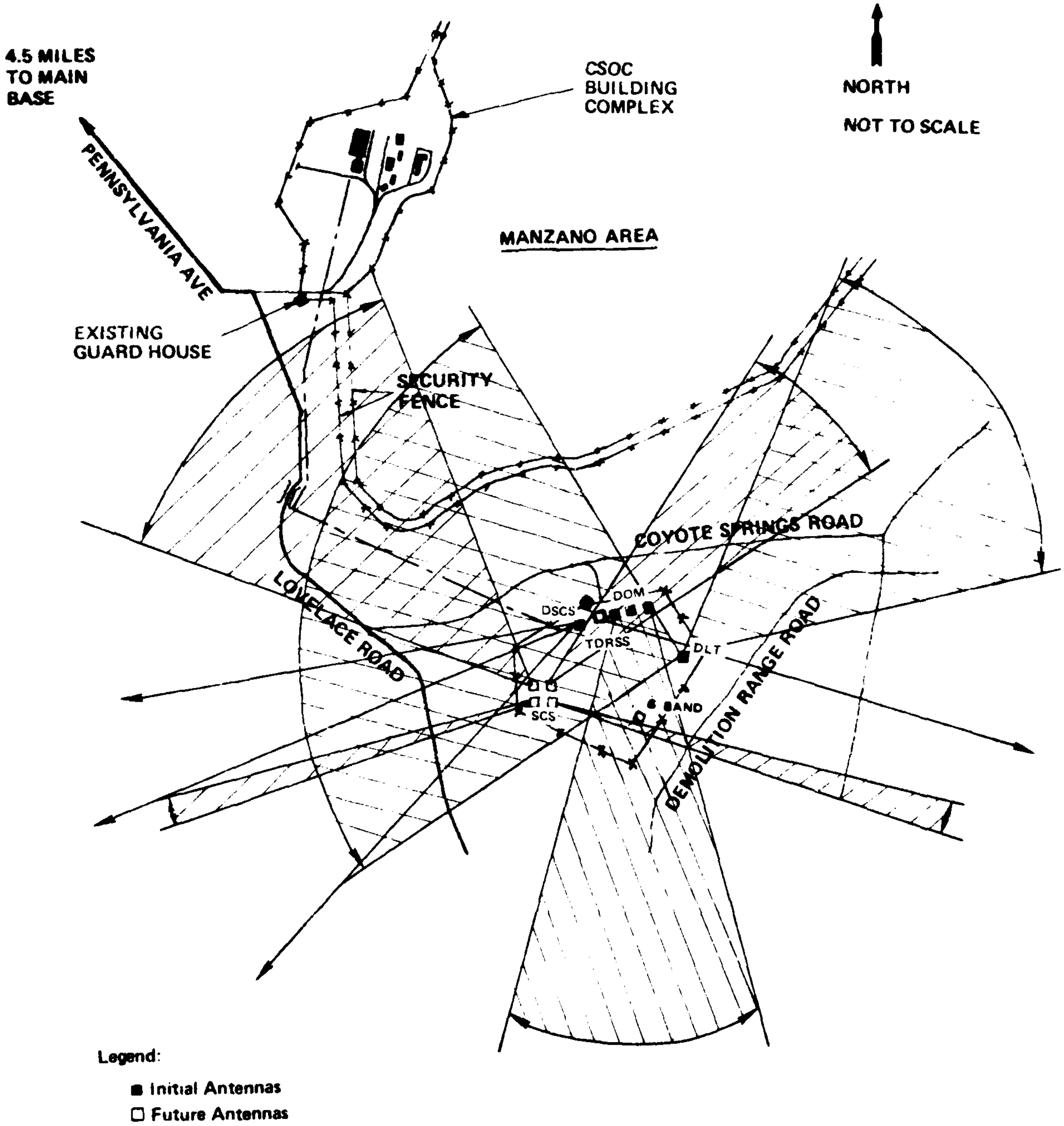

Figure 24 Antenna Viewing Sectors at Kirtland AFB

east, east and southeast, although more gently than to the north, until reaching the Cibola National Forest where mountain peaks exceed 7900 feet MSL. Most of the land in the vicinity of the CSOC facility is relatively uninhabited and undeveloped and this is particularly true at the higher elevations. Most of the buildings and activities related to the Manzano Area are located behind the mountain and are effectively shielded from CSOC antenna radiation.

IV.A.7.4.1 Personnel Safety

Using the basic assumptions to provide a 'worst case' analysis, as outlined on Page 108 of this report, theoretical calculations indicate that at elevations the same or lower than the antenna field, there will be no areas where .1 or .01 mw/cm^2 power densities are exceeded and only very small areas will experience greater than .001 mw/cm^2. This includes the more inhabited areas to the west and south as well as roads in the immediate vicinity. The most critical areas are located in the north direction on the upward sloping Manzano Mountains. For analysis in this area, two cases are considered:

- The theoretical ground level power density at increments along a line radiating outward from the DLT antenna at 329°
- The theoretical power densities at specific locations where habitation is likely

The data in Table 36 shows the theoretical ground level power densities for the initial antenna installation and secondly, with the future S-Band antenna. Power densities were determined at incremental distances along the 329° azimuth extending to the highest elevation of the nearby Manzano Mountain. Distance from the antenna field fenceline and the elevation of each specific point is also listed. The relative locations of these points are identified on Figure 25.

Table 36

Ground Level Power Density at Specific Points at Kirtland AFB/Albuquerque Location

Location	MSL Elevation (feet)	Distance from Antenna Fence (feet)	Power Density	
			Initial Ant. (mw/cm^2)	With Future Ants. (mw/cm^2)
A	5,720	0	.00026	.00089
B	5,680	700	.00022	.00055
C	5,720	2800	.00017	.00038
D	5,800	3800	.00019	.00042
E	5,900	4200	.00027	.00059
F	6,100	4900	.00110	.00230
G	6,441	6100	-0-	.04500

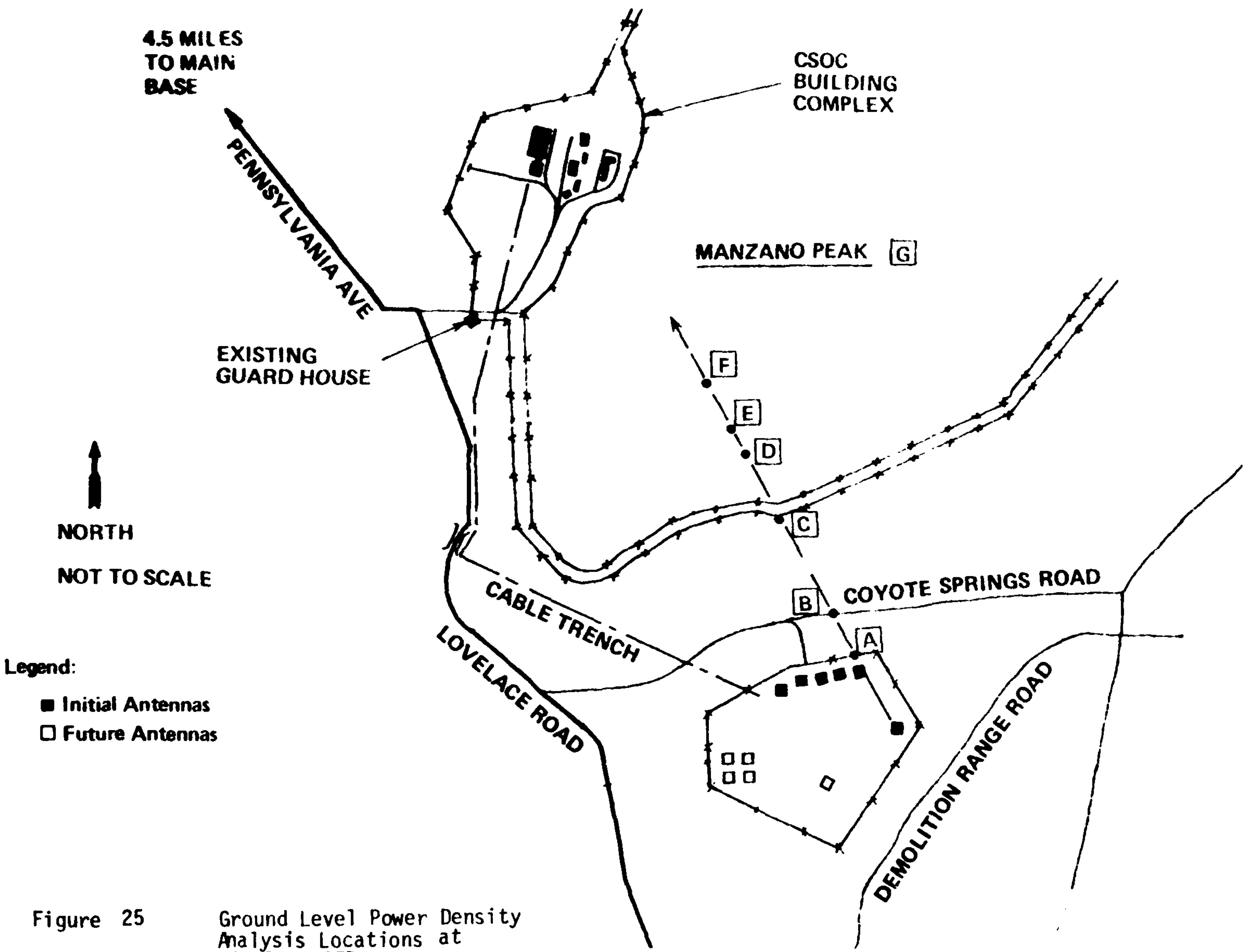

Figure 25 Ground Level Power Density Analysis Locations at Kirtland AFB

The apparent increase in power density with distance is a result of the change in elevation of Manzano Mountain. The theoretically-determined power densities are well below the MPEL of 10 mw/cm^2 and the proposed levels of 1-5 mw/cm^2.

Calculation of power densities on rooftops of CSOC buildings cannot be made until specific locations and elevations are defined. At present, most of the CSOC buildings will be located at a site sufficiently distant to preclude radiation impacts.

IV.A.7.4.2 Electroexplosive Device Safety

The criteria for various categories of EEDs are listed in Table 28. The most stringent criteria is for the S-Band and DLT antennas at 1.34 mw/cm^2 and 1.46 mw/cm^2 respectively. For the antenna installation at Kirtland AFB, no single antenna or combination of antennas is capable of producing ground level power densities of this magnitude.

Airborne EEDs must be restricted from any area where a power density level in excess of 10 mw/cm^2 can be experienced. The S-Band antenna is capable of exceeding this criteria, as indicated by the information presented in Table 35. The TDRSS antenna (not included in Table 35 since it is not proposed for either the Colorado Springs or the Malmstrom AFB locations) can attain a maximum of only .185 mw/cm^2 at a distance of 13,300 feet from the antenna and thus is not a hazard with respect to EEDs. Because of the S-Band power density in excess of 10 mw/cm^2, it is recommended that aircraft be restricted from within 1000 feet of the CSOC antenna field.

IV.A.7.5 Electromagnetic Radiation Impacts at Malmstrom AFB/Great Falls Location

The antenna layout at Malmstrom AFB is presented in Figure 26; viewing sectors are indicated by the shaded areas except for the S-Band antenna which views in a complete 360° circle.

IV.A.7.5.1 Personnel Safety

Using the basic assumptions outlined on Page IV-32 of this report, theoretical calculations for the 'worst case' analysis indicate that at elevations the same as or lower than the antenna field, there will be no areas where .1 or .01 mw/cm^2 power densities are exceeded and only in very small areas will levels above .001 mw/cm^2 occur.

At the higher elevations, particularly to the southwest, the antennas that can potentially contribute to ground level power densities are the DOMSATS, the DSCS and the future S-Band units. For a worst case analysis of ground level power densities, specific points have been selected based on highest elevations and nearness to the antenna field. The points selected for analysis are identified on Figure 26; ground level power densities at these points are presented in Table 37.

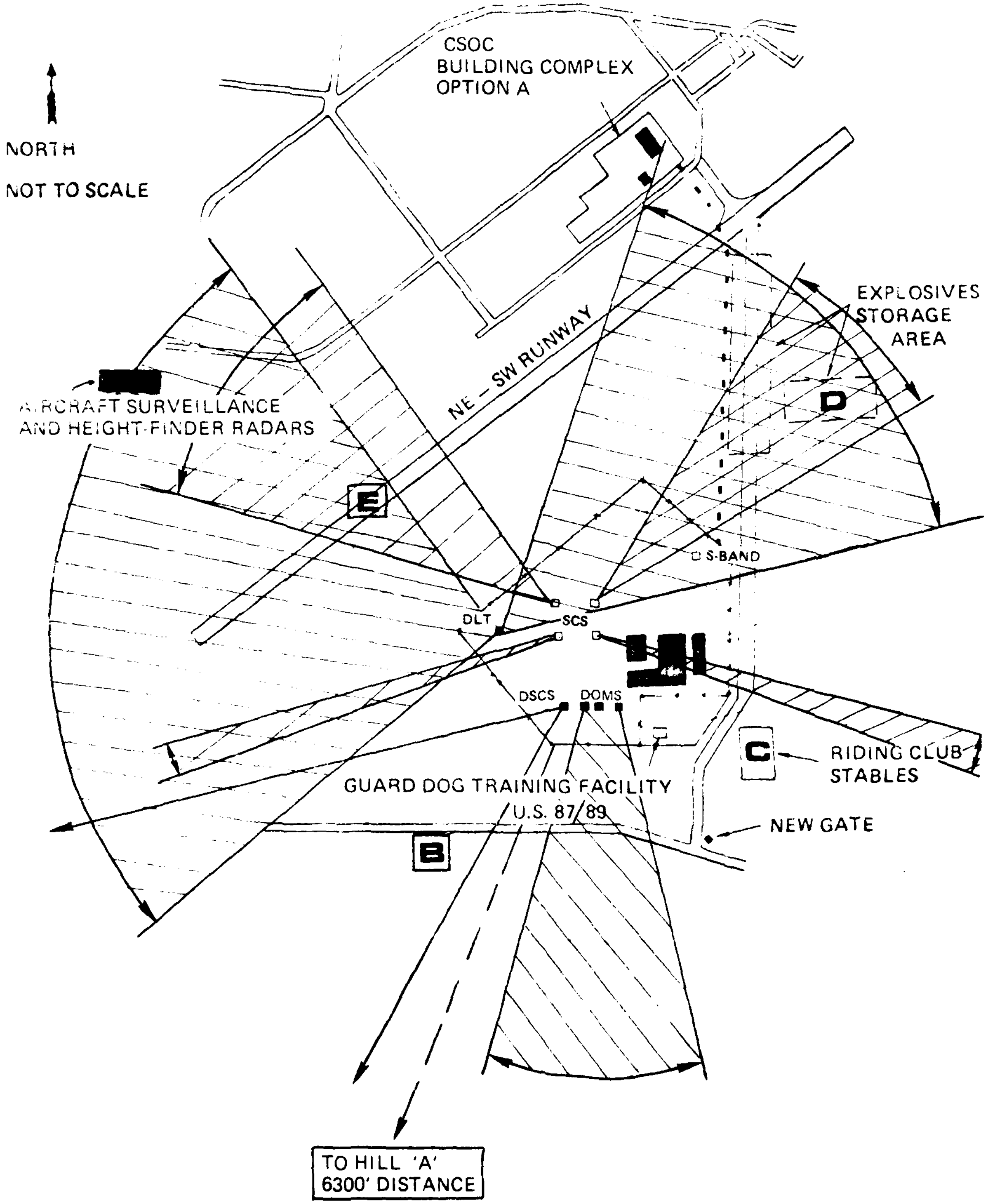

Figure 26 Antenna Layout at Malmstrom AFB

Table 37

Ground Level Power Density at Specific Points at Malmstrom AFB/Great Falls Location

Location	MSL Elevation (feet)	Power Density Initial Ants. (mw/cm^2)	Power Density With Future Ants. (mw/cm^2)
A -- Hill to SSW of antennas	3,601	.0000008	.00015
B -- Highway 87/89	3,583	.0000008	.00068
C -- Riding Stable/Gun Club	3,480	-0-	.00130
D -- Explosives Storage Area	3,390	.00018	.00041
E -- Runway at Nearest Point	3,500	.00039	.00117

The above pertains to the power densities produced by the CSOC antennas only. Malmstrom AFB has two other antennas in operation which also produce ground level power densities. These antennas are: 1) AT 0573/FPS 65 used by the FAA for aircraft surveillance, and 2) AN/FPS 90 used as a height-finder radar. These antennas are located as shown on Figure 25, approximately 5000 feet west-northwest of the CSOC antenna field.

The FPS 65 antenna is a pulsed radar unit which rotates at 5 revolutions per minute and can reach a minimum elevation angle of +2.2°. Because of the pulsed transmission characteristic, it's rotational speed and it's minimum elevation angle, ground level power densities are very low and of the same order of magnitude as those produced by the CSOC antennas. The maximum on-axis power density for this radar unit is approximately 1.6 mw/cm^2 at 600 feet from the antenna. The FPS 65 operates at 1250-1350 MHz which does not conflict with CSOC antenna frequencies. No hazardous power densities will be produced by this antenna in the area of the CSOC facilities.

The FPS 90, which operates between 2700 and 2800 MHz, is also a pulsed radar unit and operates in 360° of azimuth. However, when performing the height-finding function it locks onto an aircraft and nods up and down at a rate of 20 times a minute. The elevation angle ranges from a low of -2° to a high of +32°. The pulsed transmission and the constant nodding movement will preclude generation of hazardous power densities at ground level. Due to the design and construction of the FPS 90 antenna, it can not lock in or stop in the downward (negative) position, while operating or at rest.

Although ground level power densities produced by the FPS 90 could potentially be significantly greater than those associated with the CSOC antennas, the FPS 90 antenna will not result in hazardous levels at the CSOC facility location. The FPS 90 antenna generates maximum ground level average power density levels considerably below the 5 mw/cm^2 standard proposed by the ANSI. The contribution of the CSOC antennas would add very little to the existing EMR environment at Malmstrom AFB.

Building layouts for the CSOC facility have not been prepared for Malmstrom AFB and thus rooftop power densities have not been calculated.

IV.A.7.5.2 Electroexplosive Device Safety

The criteria for various categories of EEDs are listed in Table 28. The most stringent criteria is for the S-Band and DLT antennas at 1.34 and 1.46 mw/cm^2 respectively. For the antenna installation at Malmstrom AFB, no single antenna or combination of CSOC antennas is capable of producing ground level power densities that exceed this criteria.

Airborne EEDs must be restricted from any area where a power density level in excess of 10 mw/cm^2 can exist. The S-Band antenna can emit slightly over 10 mw/cm^2 at a distance of 473 feet from the antenna. Because of this, aircraft should be restricted from within 1000 feet of the CSOC antenna field.

IV.A.7.6 Summary of EMR Hazards

Design calculations indicate that there is no personnel/animal health hazard at ground level from emanating radiation. Field surveys will be conducted after antenna installation to verify ground level power densities in the vicinity. Subsequent to a field survey, the following measures could be taken to assure personnel safety:

- Controlled access with proper warning signs located at points of potential hazard.
- Prohibit personnel access at designated points by installing physical barricades

A summary of the theoretical analysis presented in the preceding sections indicates the following facts to be theoretically determined:

- No single antenna or any combination of antennas exceeds the U.S. MPEL criteria of 10 mw/cm^2, nor do they exceed the 1-5 mw/cm^2 criteria being considered for adoption. This is the case at all three candidate locations.
- No single antenna or combination of antennas exceeds the fuel storage criteria of 5000 mw/cm^2 at any of the three candidate locations.
- Power density in excess of the 10 mw/cm^2 criteria for EEDs transported in or on aircraft in a flight configuration is produced by the S-Band antenna in its main beam for a distance of 473 feet from the antenna. This is the case at all three candidate locations.
- Due to the absence of runways in the vicinity of the CSOC antenna field at both the Peterson AFB/Colorado Springs and Kirtland AFB/Albuquerque candidate locations, there is no hazard to EEDs on aircraft in a landing or take-off configuration at these two locations.
- The proximity of the main runway and general aircraft activity in the vicinity at the Malmstrom AFB/Great Falls location will necessitate stringent restrictions on flight operations to preclude exposure of EEDs on aircraft in a landing or take-off configuration to unsafe power density levels.

IV.A.8 Socioeconomic Impacts

IV.A.8.1 Impact on Public School Facilities

It is assumed for purposes of this analysis that all of the CSOC personnel are new residents of the respective candidate locations considered below. It is further assumed that each of the 1900 CSOC employees have families with school-age children and even though this is unlikely to be the case, it represents the maximum potential impact.

Permanent CSOC personnel will begin to locate in the selected CSOC location beginning in 1983; the greatest influx of new residents will occur in 1985 when the final 1256 CSOC employees will arrive. Table 38 presents the increase over the three-year period between 1983 and 1986; this table presents the breakdown of students by grade level and by year of arrival.

Table 38

Potential Student Population

Grade Level	1983	1984	1985	Total
K-6*	134	290	754	1,178
7-9**	67	145	377	589
10-12***	45	97	251	393
Yearly Increase	246	532	1,382	
Cumulative Total	246	778	2,160	2,160

* Based on .6 students per family
** Based on .3 students per family
*** Based on .2 students per family

IV.A.8.1.1 Impact on Educational Facilities at Peterson AFB/Colorado Springs Location

The school districts serving the Colorado Springs area and adjoining communities to the southeast, east and northeast where CSOC personnel are expected to locate, have a 1980 enrollment of 60,294 students. Each district provided an estimate of the additional number of students that could be housed in their present facilities. This estimate, when totaled for all of the districts contacted, indicates that there is room for about 12,000 more students. The bulk of this additional capacity is in District No. 11 which includes the major part of the city of Colorado Springs; this district presently has capacity for almost 10,000 more students. Table 39 on the following page, summarizes the present status of these districts.

Several of the districts included in Table 39 are presently at capacity including Harrison No. 2, Air Academy No. 20 and Falcon No. 49 (refer to Table 10). District No. 20 will open two new elementary schools in the Fall of 1981 and one high school in the Fall of 1982. Falcon District No. 49 has a 1980 bond issue which if passed by the voters, will provide funds for a new elementary school and expansion of their junior high

and one of their senior high schools; this expansion will provide room for 600 more students. Thus, by the time CSOC personnel have arrived in the Colorado Springs area, several new schools will be available with additional capacity in excess of the 12,017 spaces noted below.

Table 39

1980 Enrollment and Unused Capacity of Colorado Springs School Districts

School District	Grade Level	1980 Enrollment	1980 Unused Capacity
No. 11	K-6	16,892	5,577
	7-9	7,164	3,101
	10-12	7,670	1,255
			9,933
All Others Listed in Table 10	K-6	15,146	2,084 (Breakdown by grade level is not available)
	7-9	6,427	
	10-12	6,995	
Total of All Above Listed Districts	K-6	32,038	
	7-9	13,591	
	10-12	14,665	
		60,294	12,017

The 12,000-student margin between 1980 enrollment and capacity is almost 6 times that needed to accommodate the 2,160 potential CSOC students. However, this margin does not exist uniformly throughout the districts and to some degree the ability to house CSOC students will be a function of the number of families electing to reside in each particular district. It is reasonable to assume that new residents moving to Colorado Springs will consider the local school district's ability to accommodate their children.

IV.A.8.1.2 Impact on Educational Facilities at Kirtland AFB/Albuquerque Location

The Albuquerque Public School District has projected a total district-wide decrease in student enrollment through 1985. The present enrollment is 77,270 and this is expected to drop to 70,309 by 1985, as shown in Table 17. Concurrent with this decrease, the CSOC project will be adding students. Table 40 lists the 1980 enrollment and the district's projected enrollments for 1983, 1984 and 1985. The difference between the 1980 enrollment and that projected for each year can be assumed to represent unused capacity that would be available for housing the CSOC students. The projected CSOC student population is therefore compared to the unused capacity created by the decreasing student population and in no case do the number of CSOC students exceed the available space. The school district appears to have the facilities and personnel on a district-wide basis to handle the CSOC students, assuming that the district-wide population declines as projected.

Table 40

Effect of CSOC on Projected Student Enrollment

Albuquerque Public Schools

		1983	1984	1985
K-6	1980 Enrollment	38,040	38,040	38,040
	Predicted Enrollment without CSOC	37,165	36,996	36,725
	Decrease from 1980	875	1,044	1,315
	CSOC Students	134	424	1,178
7-9	1980 Enrollment	18,158	18,158	18,158
	Predicted Enrollment without CSOC	16,929	16,870	16,743
	Decrease from 1980	1,229	1,388	1,415
	CSOC Students	67	212	589
10-12	1980 Enrollment	21,072	21,072	21,072
	Predicted Enrollment without CSOC	17,977	17,200	16,841
	Decrease from 1980	3,095	3,872	4,231
	CSOC Students	45	142	393

As in many other developing urban areas, however, school facilities are lacking in specific sections of town where development of residential housing has occurred before new schools can be planned and built to house the students brought in by the new developments. This is the situation in the northwest and southwest areas of Albuquerque where portable classrooms and busing to other schools are being implemented to relieve overcrowded conditions. A pending bond issue will be placed before the voters in the 1980 elections, and if passed it will provide financing for construction of new schools in these areas.

IV.A.8.1.3 Impact on Educational Facilities at Malmstrom AFB/Great Falls Location

The Great Falls Public School District has been losing students since its peak enrollment year of 1970 at which time over 19,000 students were attending school. The present enrollment is 13,268 and this is projected to decline to 12,510 by 1984, and then rise slightly in 1985. Table 41 summarizes the projected district-wide enrollment by grade level for the years 1981 through 1985. Table 42 has been prepared to show the projected available space over the next few years.

Table 41

Predicted Enrollment by Grade Level in Great Falls Public Schools

Grade Level	1981	1982	1983	1984	1985
K-6	6,732	6,540	6,423	6,597	6,763
7-9	3,085	3,046	3,112	3,104	2,996
10-12	3,282	3,070	2,997	2,809	2,804
Total Year Enrollment	13,099	12,656	12,532	12,510	12,563
CSOC Students			246	778	2,160
Total Enrollment with CSOC Students included	13,099	12,656	12,778	13,288	14,723

Table 42

Projected Available Space in Great Falls Public Schools

Grade Level	1983		1984		1985	
	Avail. Space	CSOC Students	Avail. Space	CSOC Students	Avail. Space	CSOC Students
K-6	209	134	35	424	(131)	1,178
7-9	73	67	81	212	189	589
10-12	454	45	642	142	647	393

From Table 42 it is apparent that by 1984 the additional number of elementary grade (K-6) CSOC students will exceed the available space by some 389 students (424 - 35 = 389) and that by 1985 this imbalance will increase to 1,309 students (1,178 + 131 = 1,309). At the junior high level, a shortage of space will also occur in 1984 when the number of CSOC students could be 212 and there is space available for only 81; this shortage increases to 400 in 1985. The shortage of space in 1984 can probably be satisfied by opening additional classrooms at certain schools; by 1985 the excess students may be sufficient to reopen several of the schools that have been closed during recent years, particularly those at the elementary level. The high schools should be able to accommodate the additional CSOC students using presently available facilities.

IV.A.8.1.4 Summary of Public School Capacities

The relative ability of the local public school districts to accommodate school age children at any of the candidate locations is demonstrated in Table 43. In the Colorado Springs and Albuquerque areas, the influx of CSOC-project students during the 1983-1986 period will use only a portion of the available space created by the declining student population. Only in specific neighborhoods where residential development has outpaced new school construction, are classrooms expected to be overcrowded. The student population in Great Falls is also expected to decline over the next few years, but not sufficiently to make room available for all of the 2,160 CSOC students. This shortage will require re-opening of schools and hiring of additional teachers and administrative personnel at the elementary level.

Table 43

Comparison of Public School Capacities

Parameter	Colorado Springs	Albuquerque	Great Falls
Projected 1985 Capacity	72,311	77,270	13,099
Projected 1985 Enrollment without CSOC Students	≤60,000	70,309	12,563
CSOC Students	2,160	2,160	2,160
Projected 1985 Enrollment with CSOC Students	≤62,160	72,469	14,723
Under/Over 1985 Capacity	Under~10,000	Under ~5,000	Over ~1,600

IV.A.8.2 Housing Impacts

A summary of the housing market in the three candidate locations is presented in Table 44 on the following page. This data provides the current average selling prices and rental rates for various types of civilian housing in the three locations of concern. Military housing is summarized in terms of the number of units, average waiting time to obtain these units, and in the case of BAQ units the number presently vacant are listed.

In order to assess the housing availability for CSOC employees, Table 45 has been prepared which lists the recommended monthly allotments for housing. For military personnel, the Air Force-recommended allotment of no more than 25% of the monthly gross salary for housing has been listed. This gross salary includes dependent quarters allowance. For civilians it is assumed that up to 30% of their gross salary could be used for house payments or rents.

Table 44

Comparison of Housing Environments

Civilian Housing Type	Col. Springs	Albuquer.	Great Falls
Typical 3-Bedroom House For Sale:			
Sales Price	$62,241	$66,414	$60,900
Vacancy Rate	1.59%	1.65%	10.0%
Typical 3-Bedroom House For Rent:			
Monthly Rental Rate	$ 300	$ 362	$ 308
Typical 2-Bedroom Apt. For Rent:			
Monthly Rental Rate	$ 230	$ 230	$ 230
Vacancy Rate for Rental Apts. and Homes	7.75%	4.20%	10.0%
Number of Units Projected to be Vacant by 1985 (includes for sale and rental units)*	3,634	3,459	2,722
*Projected using the LECS program.			

Military Housing Type	Peterson AFB	Kirtland AFB	Malmstrom AFB
Family Quarters:			
Number of Officers Units	106	379	294
Average Waiting Time	2 months	1 month	3 months
Number of Enlisted Units	384	1755	1112
Average Waiting Time	4 months	1 month	3 months
Bachelor Quarters:			
Number of Officers Units	40	48	68
Present Vacancy Rate	0%	0%	0%
Number of Enlisted Units	812	2077	1666
Number of Units Available	27	913*	260

*Included in this figure are 3 dorms at Manzano Area containing 259 units that are presently closed.

Table 45

CSOC Personnel Average Income and Recommended Housing Allotments

Type of Personnel	Number of Personnel	Est. Average Annual Salary	Recommended Monthly House Payments/Rents
Officer	128	$26,809	$ 544
Enlisted	190	13,924	290
Civil Service	111	21,307	533
Contractors	1,413	22,500	563

Using information outlined in the previous two tables, and information presented in Section III of this report concerning housing, the following paragraphs summarize the military and civilian housing impacts at the three candidate locations.

IV.A.8.2.1 Housing Impacts at Peterson AFB/Colorado Springs Location

All family quarters for military officer and enlisted personnel (including BOQ units) are presently occupied. Current waiting periods range from 2 to 4 months. Unless there is a dramatic change in this situation, it is predictable that the majority of the military personnel assigned to CSOC may have to seek housing off-base in the civilian community. For military bachelor airmen 27 units are presently vacant and these may or may not be available when CSOC personnel arrive.

The Air Force's Local Economic Consequences Study (LECS) computer model was used to project the number of civilian housing units available by 1985 and the vacancy rate associated with the same time period. For the Colorado Springs area, LECS projected a total 1985 housing stock of 91,090 units and a 4% vacancy rate. This means that 3,634 housing units (both for sale and for rent) could be available for housing 1900 CSOC families. At the present time Colorado Springs has 2,093 vacant rental units and 716 for sale units; using this same distribution, by 1985 2718 rental units and 916 for sale units could be on the market.

Using the recommended monthly payment and rent schedules listed in Table 46 and combining this information with that presented in Table 11, the following conclusions can be drawn:

- Officers will have a wide variety of housing units in the for sale category that they can afford to buy. Almost all of the apartments and houses for rent are within their recommended housing allotment.
- Enlisted personnel will find very few homes for sale in their affordable price range. Only 1 bedroom homes and apartments are fully within their rental range although some of the older units are probably within their reach in the 2 and 3-bedroom size.

- Civil service employees and contractors will have basically the same housing opportunities in both purchased and rental units as do military officers since their recommended housing allotments are similar.

The impact of the CSOC project on the local housing stock could cause the overall vacancy rate to decrease below 2%; this would be considered an adverse impact on the housing market in that vacancy rates below 3% tend to cause artificial inflation of the selling prices and rental rates. The local housing industry, however, will most likely appraise this situation in time to respond by building additional housing units to meet the demand.

IV.A.8.2.2 Housing Impacts at Kirtland AFB/Albuquerque Location

Military housing for families (both officers and enlisted) and bachelor officers quarters are presently occupied. The waiting period for family housing, however, is averaging about one month. Bachelor enlisted quarters presently available for immediate occupancy amount to 913 units. It can be assumed that military housing for CSOC military personnel will be available within a reasonable period of time, particularly in the case of bachelor enlisted personnel.

The LECS program projects a total civilian housing stock of 145,896 units by 1985 and a corresponding vacancy rate of 2.8%. Thus, 4100 units would be on the market either for rent or for sale. The influx of CSOC personnel could cause the vacancy rate to drop well below 2% resulting in an inflation of housing prices and rental rates. This can be avoided, however, if the local housing development industry foresees the market and provides an increased supply of housing units to stabilize prices.

Combining the information presented in Tables 18 and 46, the following general conclusions can be made:

- Officers will have a wide selection of housing units in the for sale category, including 2-3- and 4-bedroom homes. Rental rates for both homes and apartments are also within their recommended housing allotments.
- Enlisted personnel may be able to purchase some of the lower-priced 2-bedroom homes, but these will be about the extent of the purchased housing that is within their allocated range. In the rental market, a wide choice is probably available only in the 1- and 2-bedroom apartment units.
- Civil service employees and contractors will have basically the same housing opportunities as military officers since their recommended housing allotments are similar.

IV.A.8.2.3 Housing Impacts at Malmstrom AFB/Great Falls Location

Military housing for families (both officers and enlisted) and bachelor officers are presently fully occupied at Malmstrom AFB. The average waiting period for family housing is 3 months. It is therefore reasonable to assume that a substantial number of the military CSOC personnel would seek housing off base in the Great Falls area. Malmstrom presently has 260 BAQ

spaces that are vacant and it is likely that sufficient spaces will be available for bachelor enlisted CSOC personnel in the 1983-1986 time period.

In the civilian housing category, Great Falls presently has a stock of 24,129 units (10,027 rentals, 14,057 owned) and a vacancy rate in both the rental and purchased categories of 10%. Over the next few years it is predicted that the housing stock will increase slightly to just over 27,000 units, but that the vacancy rate will remain at 10%. The effect of the CSOC project, if located in the Great Falls area, will be to decrease this vacancy rate by renting/purchasing local housing. If all 1900 CSOC personnel were to acquire housing in the community, the vacancy rate could decrease to 3%-5%, which is considered indicative of a stable housing market. From this standpoint, the CSOC project is a positive influence on the local housing situation.

The survey of housing prices in the Great Falls area is presented in Table 23, and combined with the information presented in Table 46 the following conclusions can be drawn:

- Officers will have a wide variety of housing ranging from 2- to 5-bedroom homes that are for sale, and rental apartments and houses of all sizes.
- Enlisted personnel may be able to purchase some of the lower-priced 2- and 3-bedroom homes only. Rental houses in the 4-bedroom size will probably not be available within their price range; 1- to 3-bedroom homes renting for $112 to $375 a month are more numerous. Rental apartments in the 1- and 2-bedroom size are available but selection in the 2-bedroom category at a reasonable rental rate within their recommended housing allotment.
- Civil service employees and contractors will have basically the same available housing market in both purchased and rental units as do officers due to their similar housing allotments.

IV.A.8.3 General Cost/Revenue Impacts

In general, the CSOC project represents a positive impact to the economy of the three candidate locations, when viewed over the long-term. In all three locations new housing is not required for providing accommodations for the incoming CSOC population, and thus increased costs to local government will be those associated with only an increase in population and not directly related to new development (extension of utilities, construction of new roads, etc.). Population-related costs include additional police and fire protection, library and other municipal services, etc. In the absence of a comprehensive fiscal impact analysis, these costs are difficult to quantify.

Local school districts will not be required to construct new schools to accommodate the CSOC student population; however, in the Great Falls area in particular, some schools may have to be re-opened and staffed. To a lesser degree, this could also be the case in certain crowded areas of Colorado Springs and Albuquerque. The cost, however,for re-opening and staffing existing schools and/or classrooms is minor compared to the cost of constructing new schools which fortunately is not required.

Revenue from the CSOC project will be generated primarily in the form of various taxes such as gasoline, cigarette, and sales taxes and State Income tax. Great Falls, however, does not collect a sales tax. Various license and permit fees (for new businesses, remodeling of homes, etc.) are additional sources of revenue that increase with population.

Local school districts will receive both State and Federal ADA (Average Daily Attendance) funds as a result of the CSOC students attending public schools. However, in all three candidate locations the CSOC student population will merely replace some of the declining student enrollment and thus, rather than the CSOC representing an increase in ADA funds over those presently received, it will reduce the loss of ADA funds due to the declining student population in each location. Federal ADA funds are provided for students of parents who work on military projects and in this case, all of the 2,160 CSOC students will qualify for Federal ADA funds. Based on the current allocation of $212 per student, local school districts could receive a maximum of $444,868 in Federal ADA money as a result of the CSOC project.

IV.B Relationship of Proposed Action and Objectives of Land Use Plans, Policies and Controls

IV.B.1 Peterson AFB/Colorado Springs Location

Land use plans, policies and controls will be discussed as they relate to the selected location for the CSOC facility on state-owned property east of the city limits, and as they pertain to the overall development plans for the Colorado Springs area.

Development policies for the Colorado Springs urban area are set forth in several documents, one of which is the "Development Framework for the Pikes Peak Region" prepared in October 1977 by the PPACG.* This document emphasizes the need to pursue a combination of both selective infilling of vacant developable land within the city limits and selective annexation of land that is a logical extension of existing development.

The Colorado Springs City Council has approved a similar policy governing development in the Colorado Springs planning area, stating "The City should consider the possibility of providing full urban services to lands within the Planning Area and should not provide any services outside the Planning Area with the exceptions of 1) existing contractual commitments for utilities, 2) airport development, or 3) region-wide programs such as economic development or future wastewater treatment plans. Within the Planning Area services should only be provided for developments which are adjacent to existing developed areas, consistent with open space and all other adopted land development policies." The Comprehensive Plan Program of Colorado Springs does not advocate a rapid expansionist posture and it specifically discourages annexations outside the Planning Area except for airport and possibly open space purposes. The Planning Area is essentially confined to the urban area of Colorado Springs; future growth areas are based on the premise that the city should not develop eastward because of the combination of adverse effects both from and on the operation of the municipal airport and the exacerbation of east-west traffic, which creates more adverse air pollutant problems than does expansion of the city in a linear north-south direction.

The County Planning Department has recently released its amended "Land Development Code"; this document contains numerous land development guidelines applicable to the development of county unincorporated area. One of these guidelines states "It is the policy of the County to encourage development which utilizes existing services and facilities without overburdening such facilities and services, or resulting in the need to provide additional services and facilities.

The above city, county and regional government policies and guidelines, and personal conversations with a number of city/county/PPACG staff personnel, raise the issue of growth inducement of the CSOC project simply because it is located 10 miles east of the planned growth area of the city. This will be discussed more extensively in the following paragraphs.

The location proposed for the CSOC installation is about 10 miles beyond the city limits of Colorado Springs. There are virtually no urban developments along Highway 94 nor in the immediate vicinity of Enoch Road. Both city and county government under the umbrella organization of the Pikes Peak

*Pikes Peak Area Council of Governments

Area Council of Governments participate in land use planning for the region. Land use jurisdiction is the ultimate responsibility of El Paso County since the area including the CSOC location, is in unincorporated county territory. As mentioned above, the PPACG, the city of Colorado Springs, and the county of El Paso have all discouraged expansion eastward. Some of the reasons for this are the physical and economical constraints encountered with extension of utilities over a major north-south ridge, transportation corridor efficiency in the north-south directions along the Front Range, and more favorable conditions for dispersing air pollutants along the Front Range compared to the High Plains area.

The county land east of Colorado Springs is presently not zoned. In the absence of both zoning and general planning for the CSOC location and the surrounding area, unplanned and unregulated development that could be induced by the CSOC facility is justifiably of concern to local government. Specifically, the location of the CSOC facility far removed from urban services is a strong inducement for spot development of commercial enterprises such as service stations, fast food restaurants, etc. County zoning placed on land along Highway 94 and in the immediate vicinity of the CSOC would provide a mechanism to protect the integrity of both the CSOC facility and the established farms in the CSOC area. City and county policies that discourage urban development east of Colorado Springs could therefore be implemented through the zoning mechanism.

The existence of the Front Range Project should also be mentioned when discussing land use plans and policies. The Governor of Colorado has established the Front Range Project and has appointed a Coordinating Board (comprised of volunteers representing public and private sectors in the Front Range Corridor of Colorado) to identify a set of development goals for growth of the Front Range. (NOTE: The Front Range is defined as the 200-mile long urbanizing strip from Fort Collins to Pueblo.)

IV.B.2 Kirtland AFB/Albuquerque Location

The Comprehensive Plan for Kirtland AFB acknowledges the inter-relationship between natural and man-made environments, social characteristics and needs, and the dependence between the base and surrounding community. A Memorandum of Understanding is in effect signifying cooperation of the base with the State Planning Office and the Middle Rio Grande Council of Governments on coordination and implementation of local and regional land use and environmental policies. The base has adopted land use development policies which restrict, and in some cases prohibit land uses that produce any kind of pollutant that would impair or interfere with the aircraft operations on the base and at the jointly-operated municipal airport.

The location and operation of the CSOC facility does not conflict with any of the base's adopted policies or present land uses because of its location sufficiently removed from the airport runways. In addition, the CSOC operation does not generate pollutants of any significant amount. The proposed Gibson East Corridor is to be constructed north of the Manzano Area sufficiently removed from the CSOC area so as not to be affected by the CSOC.

IV.B.3 Malmstrom AFB/Great Falls Location

A joint city/county Planning Board has been established in the Great Falls area for planning and controlling land uses both within the city and in a 4.5-mile border around the city limits. Development between Great Falls and Malmstrom AFB is primarily residential; commercial establishments are located the entire length of 10th Avenue South, on the east end of 2nd Avenue North, and in the downtown area. Industrial uses are encouraged to locate northwest of the base on the west side of the Missouri River. The remaining areas surrounding the base are reserved for agriculture. Major agriculture in the area includes wheat farming and livestock grazing. Nearly all the farm land in these areas is privately owned, with most holdings larger than 200 acres. The proposed South Bypass Arterial could encourage development in the area south of town (southwest of the base) where the Land Use Projection Plan adopted by the city/county Planning Board shows primarily residential development.

The CSOC facility would be constructed entirely within the base boundaries under either Option A or B. Both options would utilize the area southeast of the main runway for the antenna field, a portion of which had been previously planned for the base golf course. Most of the area to be impacted by the antenna field is presently unused, with the exception of a guard dog training facility that would have to be relocated if Option B is selected. (NOTE: Option A would not require removal of the guard dog facility.) A small area on the north end of the antenna field is presently used as a fire training site; this activity could easily be practiced elsewhere on the base. Other than these minor conflicts in land use, the base Master Plan does not preclude either Option A or B.

IV.C Adverse Environmental Effects Which Cannot be Avoided Should the Proposed Project be Implemented

As stated throughout this report, there are no significant adverse impacts identified for the proposed CSOC project. Nevertheless there are some adverse impacts which cannot be avoided if the CSOC is established and recommended mitigation measures are not implemented. These are:

- Potential to induce commercial developments on Highway 94 in the Colorado Springs location where local governmental policies discourage growth.
- Visual obtrusion of CSOC facility in an otherwise rural landscape setting at the Colorado Springs location.
- CSOC will add to traffic congestion on existing roads, highways and at specific intersections, at all three locations.
- CSOC will cause an increase in air pollutant emissions added to the regional air quality in all three locations which are presently non-attainment in certain pollutant categories.
- CSOC may cause local school districts to re-open classrooms and hire additional teaching and administrative personnel.

IV.D Relationship Between Short-Term Uses of Man's Environment and Long-Term Productivity

Construction and operation of the CSOC will not significantly alter the present environmental and aesthetic characteristics of the Alternate 1 or Alternate 2 locations (i.e., Kirtland AFB/Albuquerque and Malmstrom AFB/Great Falls, respectively). The Peterson AFB/Colorado Springs location, however, involves the use of land that is occasionally used for livestock grazing and is occupied sporadically by other forms of wildlife, none of which are on the endangered or threatened species lists. The CSOC will cause certain wildlife, most notably predatory birds and large mammals such as the Pronghorn Antelope, to avoid the area. This is not considered a significant impact in view of the vast open plains to the east. The antenna structures will be visible from Highway 94 and Enoch Road, and by several citizens residing in nearby farmhouses. The lack of other structures in the immediate area (as is not the case at Malmstrom AFB/Great Falls where CSOC antennas will be visible from nearby highways) causes the CSOC facility to be more prominent and intrusive on the existing rural landscape.

The influx of CSOC personnel and their families will create economic benefits at each of the three locations, which will prevail over the lifetime of the facility. In each region local business will be stimulated and unemployment will tend to decrease.

The project will cause a minor degree of degradation in the air quality at all three locations. The use of natural gas at the CSOC facility could accelerate the eventual shortage of this fuel at all three locations. The Air Force has therefore commissioned an Energy Study in which alternative heating methods including co-generation, use of other fuels, and solar heating are being evaluated. The results of this study will tend to extend the natural gas supply by using alternative methods of heating.

The long-term productivity of the CSOC is its ability to act as a second control element to augment the Satellite Control Facility operations at Sunnyvale, California (i.e., the SOC function), and secondly, to provide secure control of all military Space Shuttle operations (i.e., the SOPC function). Both of these roles are considered crucial with respect to protecting national security data, responding to national defense priorities, and enabling direct mission authority over military Shuttle missions. The United States' national defense posture will be enhanced over the long-term because of these functions.

IV.E Irreversible or Irretrievable Commitments of Resources

The CSOC project will involve limited commitments of irreversible and/or irretrievable resources. In the Peterson AFB/Colorado Springs location the facility would be located on property that is presently available for other uses such as farming, livestock grazing. Thus, the CSOC represents a long-term commitment of the land with only limited expectation of a return to the pre-project conditions. The alternate locations on the other hand, involve property that is already set aside for military/defense purposes on existing Air Force bases.

The rural landscape at the Peterson AFB/Colorado Springs location would be altered by the CSOC antennas and buildings. Furthermore, unless local government is able to establish controls on land development, the presence of the CSOC facility would have the potential to induce spot commercial developments on Highway 94. This would be considered an irreversible impact by those governing agencies that have planning jurisdiction in the region.

Operation of the CSOC would involve the irreversible consumption of water, natural gas and power. Depending on the results of the Energy Study previously mentioned, energy conservation methods may be able to minimize the consumption of natural gas.

The CSOC will cause a relocation of potentially as many as 6,100 persons. The number of relocated personnel will vary with the ability of the three locations to provide the required skilled labor force demanded by the CSOC. Energy consumed by the CSOC population would have been consumed anyway, and therefore energy consumption by the CSOC population is not in addition to that already consumed.

If air quality is considered as a local resource, then the CSOC personnel and their families will irreversibly add to the degradation of the air at any of the locations considered. At the same time, however, CSOC personnel will be adding to the improvement of air quality in areas from which they relocated.

BIBLIOGRAPHY

General

Local Economic Consequences Study (LECS) of the Proposed Realignment at Hancock Field New York; Hammer, Siler, George Associates, Washington D.C., July 1979.

Socioeconomic Impact Assessment Methodology Handbook; Stanford Research Institute International, Menlo Park, Calif., February 1979.

Peterson AFB/Colorado Springs

Air Quality Maintenance Plan for the Colorado Springs Urbanized Area: Pikes Peak Area Council of Governments; September 12, 1979.

Alternative Population and Employment Forecasts, El Paso County 1980-2000; Pikes Peak Area Council of Governments, 1976.

Base Level Resource Statement; 46 Aerospace Defense Wing, Peterson AFB, Management Analysis Office, September 30, 1979.

Colorado Springs Area Homes Illustrated; Colorado Springs Board of Realtors, February 16, 1980.

Colorado Springs Community Audit; Economic Development Department, Colorado Springs Area Chamber of Commerce, August 1979.

Colorado Springs Manpower Summary; Colorado Department of Labor and Employment, Denver, Colorado, November 1979.

Colorado Springs Sun: Classified Ads; Sunday, January 22, 1980.

Colorado Springs: The Headquarters Habitat; Colorado Springs Area Chamber of Commerce, 1978.

Community Development Block Grant, Final Application; El Paso County Land Use Department, May 1979.

Comprehensive Plan Program General Land Development Recommendations: Planning Information Report Two; Colorado Springs Planning Department, July 1975.

Development Framework for the Pikes Peak Region; Pikes Peak Area Council of Governments, October 1977.

Economic Adjustment Program, Colorado Springs, Colorado: U.S. Air Force Aerospace Defense Command Realignment; Presidents Economic Adjustment Committee, Office of Economic Adjustment, Pentagon, Washington D.C., December 1979.

Environmental Resources Study for Teller and El Paso Counties: Part G, Climate and Design; Michael D. McAnelly, 1974.

Formal Environmental Assessment for the Proposed Reorganization of the USAF Air Defense and Surveillance/Warning Resources; HQ AFESC, HQ MAC, HQ SAC, HQ TAC, July 10, 1979.

Front Range Project: The First Year; Governors Office, 124 State Capitol, Denver, Colorado, November 12, 1979.

Historic Sites and Structures: El Paso County, Colorado; El Paso County Land Use Department.

Housing Market Analysis: Pikes Peak Region; Pikes Peak Area Council of Governments, May 1979.

Local Area Personal Income 1971-1976; Volume 8 Rocky Mountain Region, U.S. Department of Commerce, August 1978.

Master Plan for the Extraction of Commercial Mineral Deposits: El Paso County, Colorado; Dr. John H. Lewis and T. M. Sundran, May 14, 1975.

Peterson Air Force Base Statistics; Management Analysis Officer, Peterson AFB, October 1979.

Population and Economic Activity in the United States and Standard Metropolitan Statistical Areas: Historical and Projected 1950-2020; Environmental Protection Agency, Water Quality, Washington D.C., July 1972.

Project Aquarius: Areawide Water Quality Management Plan for El Paso and Teller Counties; Pikes Peak Area Council of Governments.

Quarterly Economic Indicators: Pikes Peak Region; Pikes Peak Area Council of Governments, 3rd Quarter, 1979.

Report to the Public, 1979, Volume I: Activity Summary; Air Quality Control Commission; Colorado Department of Health.

Report to the Public, 1979, Volume 2: 1979 Report to the Public; Air Quality Control Commission; Colorado Department of Health.

Small Area Projections: Population, Employment, Housing Units and Land Use: Pikes Peak Region 1973-2000; Pikes Peak Area Council of Governments, October 1977.

Soil Resource Analysis of El Paso and Teller Counties, Colorado; LAINCO Land Inventory Consultants, Fort Collins, Colorado, November 25, 1974.

TAB A-1 Environmental Narrative, Phase II Chidlaw Building, Peterson Air Force Base Norad Combat Operations Center, Colorado Springs, October 15, 1977.

Water Resources, El Paso County, Colorado (Colorado Water Resource Circular No. 32); Russell K. Livingston, John M. Klein, and Donald L. Bingham, U.S. Geological Survey.

1979 Annual Report for the Urban Transportation Planning Process of the Colorado Springs Urban Area; Pikes Peak Area Council of Governments.

Kirtland AFB/Albuquerque

A Land Use Compatibility Study for: Albuquerque International Airport/Kirtland Air Force Base, September 1978.

Albuquerque, Bernalillo County, New Mexico; Department of the Air Force, Albuquerque Industrial Development Service Inc., Industrial Foundation of Albuquerque.

Albuquerque Journal: Classified Ads; Sunday February 17, 1980.

Albuquerque Homes Illustrated; Photo Journal Press of the West, January 19, 1980.

Albuquerque Public Schools Comparison of 40-day Enrollments from 1970-71 to 1979-80; Office of Deputy Superintendent, November 1979.

Albuquerque Public Schools Student Enrollment: History and Forecast 1954-1999; Organization, Analysis and Research, June 1979.

Areawide Housing Opportunity Plan for State Planning and Development District III; Middle Rio Grande Council of Governments of New Mexico.

Bachelor Housing and Transient Facilities Utilization/Occupant Report; Billeting Office, Kirtland AFB, December 31, 1979.

Base Level Resource Statement FY 79; 1606th Air Base Wing, Management Analysis Branch, Comptroller Division, Kirtland AFB, September 1979.

Center for Anthropological Studies (Bulletin); Albert E. Ward, Director, Albuquerque.

City of Albuquerque Housing Assistance Plan 1979-1982; City of Albuquerque Planning Department.

Comprehensive Plan: A Summary Report, Albuquerque/Bernalillo County.

Energytic New Mexico . . . . The Power State; Second Edition, Philip R. Grant Jr., Albuquerque Industrial Development Service Inc., Industrial Foundation of Albuquerque.

Local Area Personal Income 1971-1976; Volume 7 Southwest Region, U.S. Department of Commerce, August 1978.

Monthly Economic Indicators, October 1979, Albuquerque SMSA, Bernalillo and Sandoval Counties; Albuquerque Industrial Development Services Inc.

New Mexico Annual Planning Report, Fiscal Year 1980; New Mexico Department of Human Services, Employment Service Division, Research and Statistics Section.

New Mexico Labor Market Review; New Mexico Employment Security Department, Research and Statistics Section, Volume 8, No. 11, January 1980.

New Mexico Progress; First New Mexico Bankshare Corporation, Albuquerque, New Mexico, November 1979.

Population and Economic Activity in the United States and Standard Metropolitan Statistical Areas: Historical and Projected 1950-2020; U.S. Environmental Protection Agency, Water Quality, Washington D.C., July 1972.

Southeast Area Route Study: Gibson East and Tijeras Arroyo Routes; Subarea Task Force of the Transportation Coordinating Committee and Middle Rio Grande Council of Governments, September 1976, Revised November 1976, Second printing, January 1978.

State of New Mexico Ambient Air Quality Data Summaries; 1973-1976.

State of New Mexico Health and Environment Department, Environmental Improvement Division, Air Quality Section, Annual Report 1979.

TAB A-1 Environmental Narrative; Base Environmental Coordinator and Civil Engineer, Kirtland Air Force Base, December 15, 1975, Revised December 1976 and January 1979.

TAB A-1 Kirtland Air Force Base; Department of the Air Force Headquarters 1606th Air Base Wing (MAC), Kirtland AFB, New Mexico.

The Economy 1978; Bank of New Mexico and Bureau of Business and Economic Research, University of New Mexico, Albuquerque, New Mexico.

1979 Overall Economic Development Program; New Mexico State Planning and Development District 3, Middle Rio Grande Council of Governments.

Malmstrom AFB/Great Falls

Cascade County Development Plan; City/County Planning Board, 1979.

Central Heating Plant Proposal, Draft Environmental Impact Statement, Malmstrom Air Force Base, October 1979.

Employment and Earnings in the Mountain-Plains Region; U.S. Department of Labor, Bureau of Labor Statistics, November 1979.

Economic Adjustment Program: Great Falls, Montana; Stanford Research Institute, Discussion Draft, August 27, 1979.

Economic Base Study, City of Great Falls, Cascade County, Montana; T.H.K. Associates and Great Falls City/County Planning Board, 1974.

Economic Impact, January - December 1978; Headquarters 341st Strategic Missile Wing, Management Analysis, Malmstrom AFB, Montana.

General Soil Map and Interpretations for Resource Planning in Cascade County, Montana; U.S. Department of Agriculture, Soil Conservation Service, 1969.

Great Falls Homes and Real Estate; Century Publishing, Coeur d'Alene, Idaho, January 23, 1980.

Great Falls Housing Vacancy Survey; Federal Home Loan Bank of Seattle, June 1979.

Great Falls Tribune, Classified Ads; Tuesday February 5, 1980.

Housing Assistance Plan 1979-1982, Great Falls, Montana; Community Development Department.

Local Area Personal Income 1971-1976; U.S. Department of Commerce, Volume 8, Rocky Mountain Region, AUgust 1978.

Montana Employment and Labor Force; Research and Analysis Section, Employment Security Division, Dept. of Labor and Industries, Helena, Montana, December 1979.

Population and Economic Activity in the United States and Standard Metropolitan Statistical Areas: Historical and Projected 1950-2020; U.S. Environmental Protection Agency, Washington D.C., July 1972.

Resource Statement Commanders Facts Book; Malmstrom Air Force Base, Management Analysis Branch, Comptroller Division, 341st Strategic Missile Wing, September 30, 1979.

Social and Economic Statistics Administration Bureau of the Census, Great Falls Montana 1970 Census Data; U.S. Dept. of Commerce.

The Outlook for Montana Cities; Paul E. Polzin, Montana Business Quarterly, Spring 1979.

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APPENDIX A

Electromagnetic Radiation Calculations

On-Axis Power Density Calculations

All on-axis power density calculations were made using the formulae and methods of T.O. 31Z-10-4, Electromagnetic Radiation Hazards, Air Force Communications Service (E-1 Standard), dated 1 August 1966, and Change 2, dated 1 June 1971. Ground level radiation calculations were based on Federal Commmunications Commission Rules and Regulations 25.209, Antenna Performance Standard. These regulations define the maximum antenna gain envelope outside the main beam for all antennas used for satellite communications.

Far-Field Distance - R_{FF}

L = Antenna Diameter, feet
λ = Wavelength, feet

$$R_{FF} = \frac{L^2}{\lambda}$$

Near-Field Distance - R_{NF}

$$R_{NF} = .25\ R_{FF}$$

Gain Factor, $\theta L/\lambda$, Illumination, Antenna Efficiency

Antenna	$\theta L/\lambda$	Gain Factor-F	Illumination-I	Antenna Efficiency-*
DSCS	66.7	1.0	Uniform	.583
DOMSAT	62.3	1.0	Uniform	.647
DLT	64.2	1.0	Uniform	.553
SCS	60.4	1.0	Uniform	.501
S Band	64.5	1.0	Uniform	.74
X Band	64.9	1.0	Uniform	.638
TDRSS	60.4	1.0	Uniform	.550

*Antenna Efficiency, K . . . .

$$K = \frac{G\lambda^2}{\pi^2 L^2 F}$$ Note: K should lie within .5<K<.9.

where

θ = Half-Power Beam Width, $^{\circ}$
L = Antenna Diameter, ft
λ = Wavelength, ft
F = Gain Factor
I = Illumination (from Table 4-9 of T.O. 31Z-10-4)
G = $\log^{-1}$ dB/10 (antenna gain - non-dimensional)

Reference Power Density at $D = 2L^2/\lambda$

$$W_o = \frac{P_t\, G\, \lambda^2}{16\pi L^4}$$

where:
P_t = Peak Power, watts
G = Antenna Gain
λ = Wavelength, cm
L = Antenna Diameter, cm

DSCS	W_o = .145 mw/cm^2
DOMSAT	W_o = .009 mw/cm^2
DLT	W_o = .090 mw/cm^2
SCS	W_o = .195 mw/cm^2
S Band	W_o = .360 mw/cm^2
X Band	W_o = .397 mw/cm^2
TDRSS	W_o = .0071 mw/cm^2

Far-Field On-Axis Power Density - W_f

$$W_f = \frac{P_t\, G_t}{4\pi D^2}$$

where:
W_f = Power Density, watts/cm^2
P_t = Peak Power, watts
G_t = Antenna Gain
D = Distance from antenna, cm.

Near-Field Correction

Near-field correction must be applied as a function of the illumination of the antenna. For on-axis calculations of power density, the curves of T.O.31Z-10-4 are used. The distance from the antenna is normalized to unity at $2L^2/\lambda$ as follows:

$$P' = \frac{D}{2L^2/\lambda}$$

where:
P' = Normalized Distance
D = Distance from Antenna, ft
L = Antenna Diameter, ft
λ = Wavelength, ft

The $\bar{x} = 0$ on-axis curve is used for each P' value to read off the factor $\bar{w}$ by which the reference power density W_o must be multiplied to obtain the power density W_n at the distance D. That is,

$$W_n = W_o \cdot \bar{w}$$ where $\bar{w}$ is a normalized power density factor

The results of these calculations have been plotted on Figures 1 through 7 for each antenna. These curves show the on-axis power density (mw/cm^2) versus the distance from the antenna along the axis (feet) for normal and peak operating power. Analysis in this report is based on peak power since this is the worst case.

Ground Level Power Density Calculations

Figure 8 shows an artist's concept of a constant power density envelope surrounding the antenna beam centerline. For a given power density, it can be seen that the ground plane may intersect the constant power density envelope forming a 'footprint' within which ground level power densities will be in excess of the envelope value. As distance from the antenna increases, the footprint diminishes in width. Beyond the ground limit distance the envelope rises to meet the beam centerline at the maximum distance the given power density can occur. Therefore, at ground level the area of concern consists of the dimensions of the shaded area.

In calculating the ground level density, it is necessary to consider the antenna beam elevation angle, the height of the beam centerline at the antenna, the elevation of the antenna, the elevation of the point where power density is to be calculated and the distance between this point and the antenna.

Since in most cases the main beam is pointed well above ground level, the power density at the ground is a result of side lobes which contain much less power than the main beam. The curves shown in Figure 9 show the attenuation of main beam power density as a function of degrees off-axis.

Figure 10 shows the geometry involved in determining the off-axis degrees (Σ) and the on-axis distance (R), which are required to calculate the power density at a given point on the ground (P). The mean sea level elevations of the antenna and the point (P) and the distance (D) are taken from U.S.G.S. Topographical maps. The antenna centerline height and the minimum elevation angle (θ) are given as part of the antenna parameters. The off-axis degrees (Σ) and distance (R) are calculated by trigonometric methods. The attenuation factor for (Σ) is determined from Figure 9 and the on-axis power density at distance (R) is determined from Figures 1 through 7. The power density at (P) is calculated using the following relationship:

Power Density = On-Axis Power Density x Attenuation Factor.

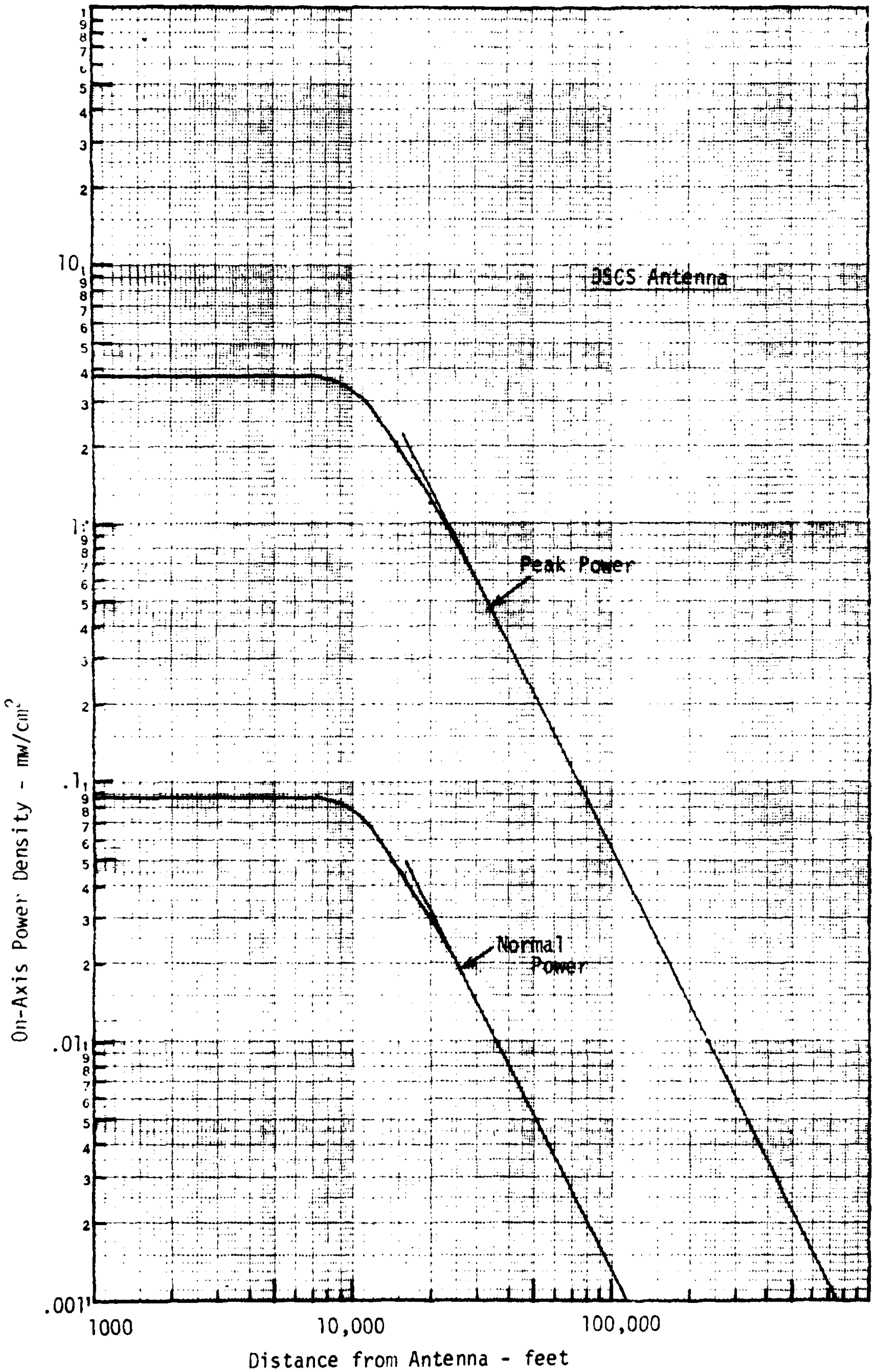

DSCS Antenna
Peak Power
Normal Power
On-Axis Power Density - mw/cm^2
10
1
.1
.01
.001
1000
10,000
100,000
Distance from Antenna - feet

Figure 1

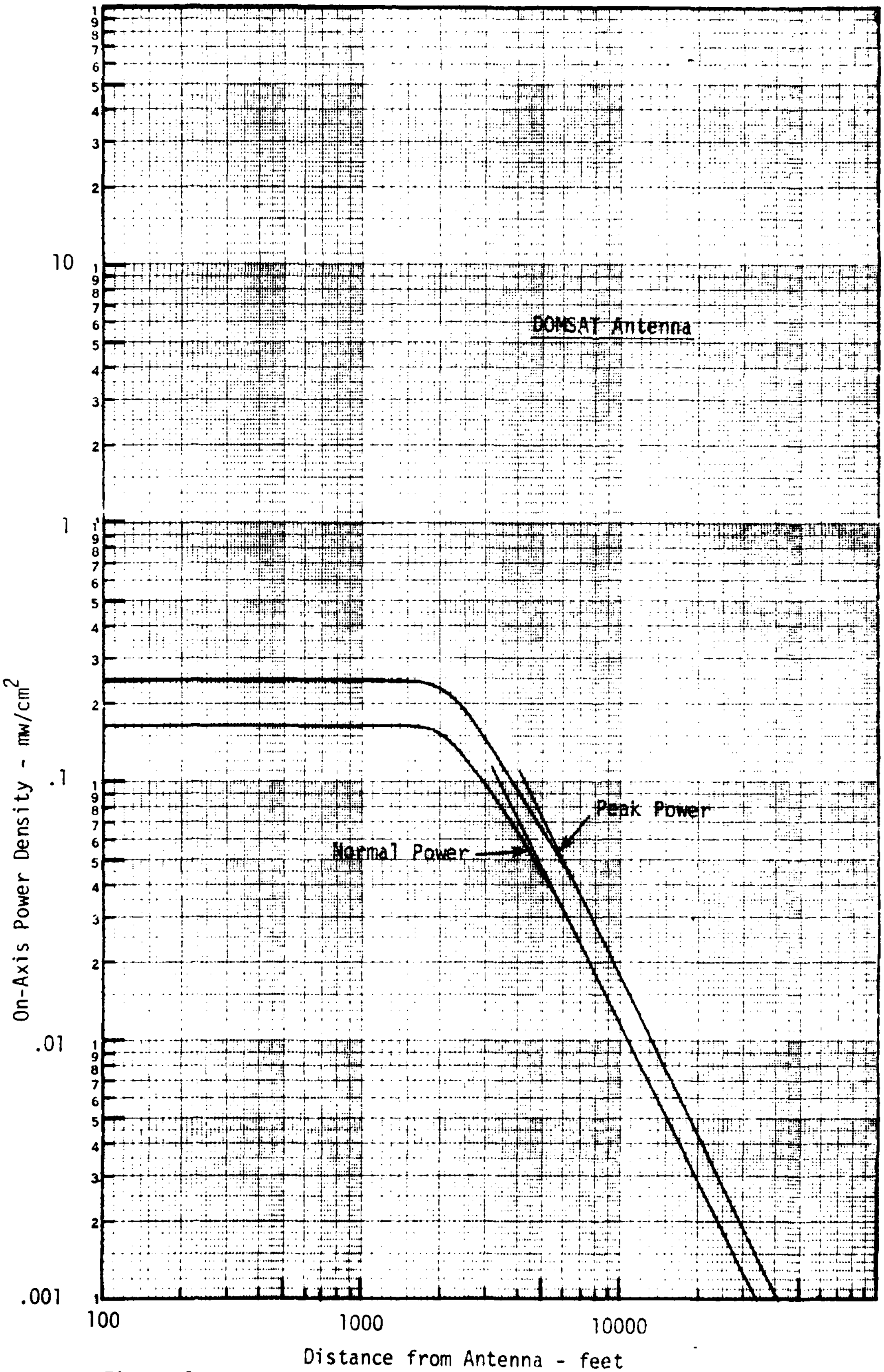
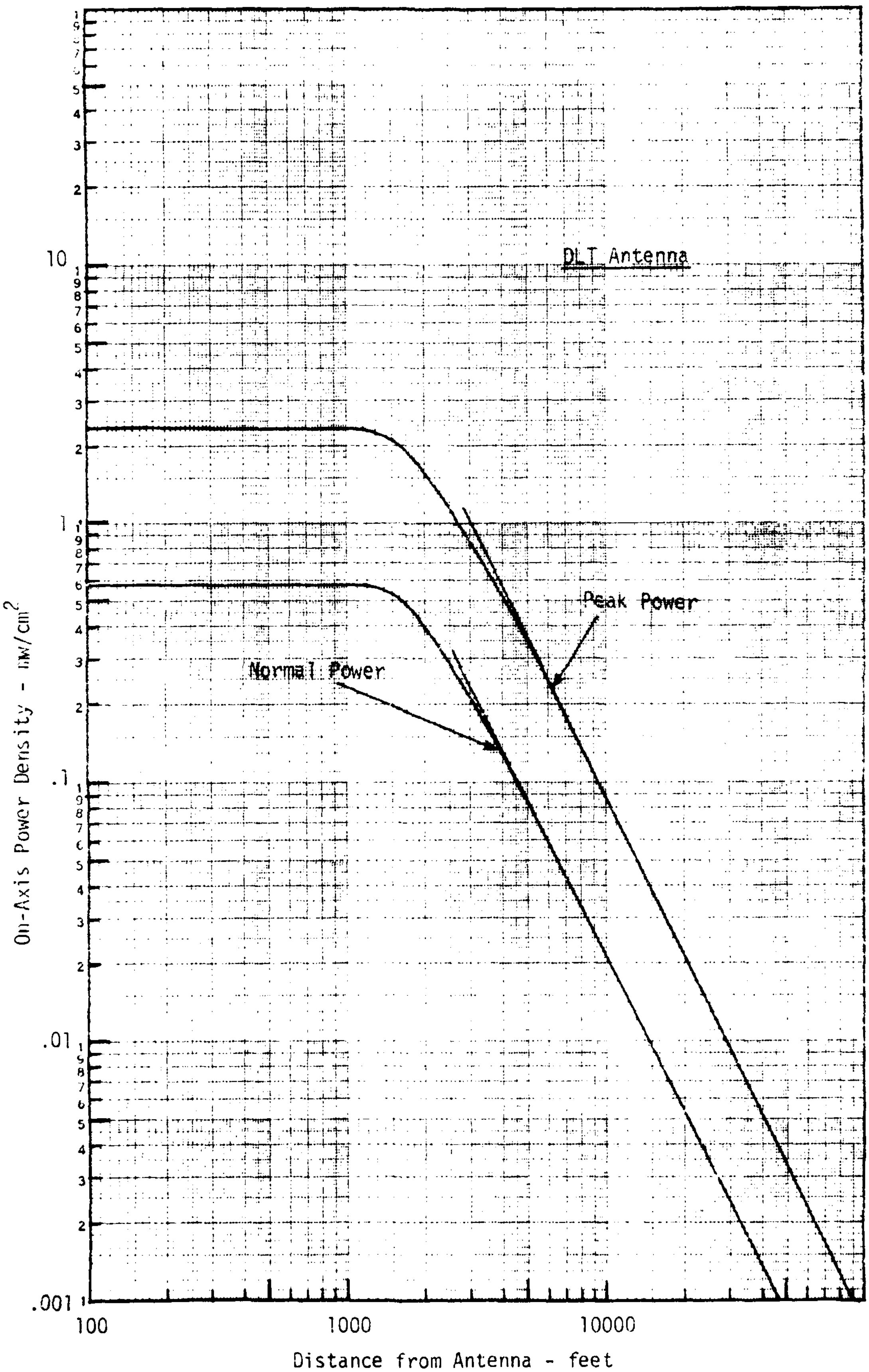

DOMSAT Antenna
Peak Power
Normal Power
On-Axis Power Density - mw/cm2
10
1
.1
.01
.001
100
1000
10000
Distance from Antenna - feet

Figure 2



DLT Antenna
Peak Power
Normal Power
On-Axis Power Density - mW/cm^2
10
1
.1
.01
.001
100
1000
10000
Distance from Antenna - feet

Figure 3

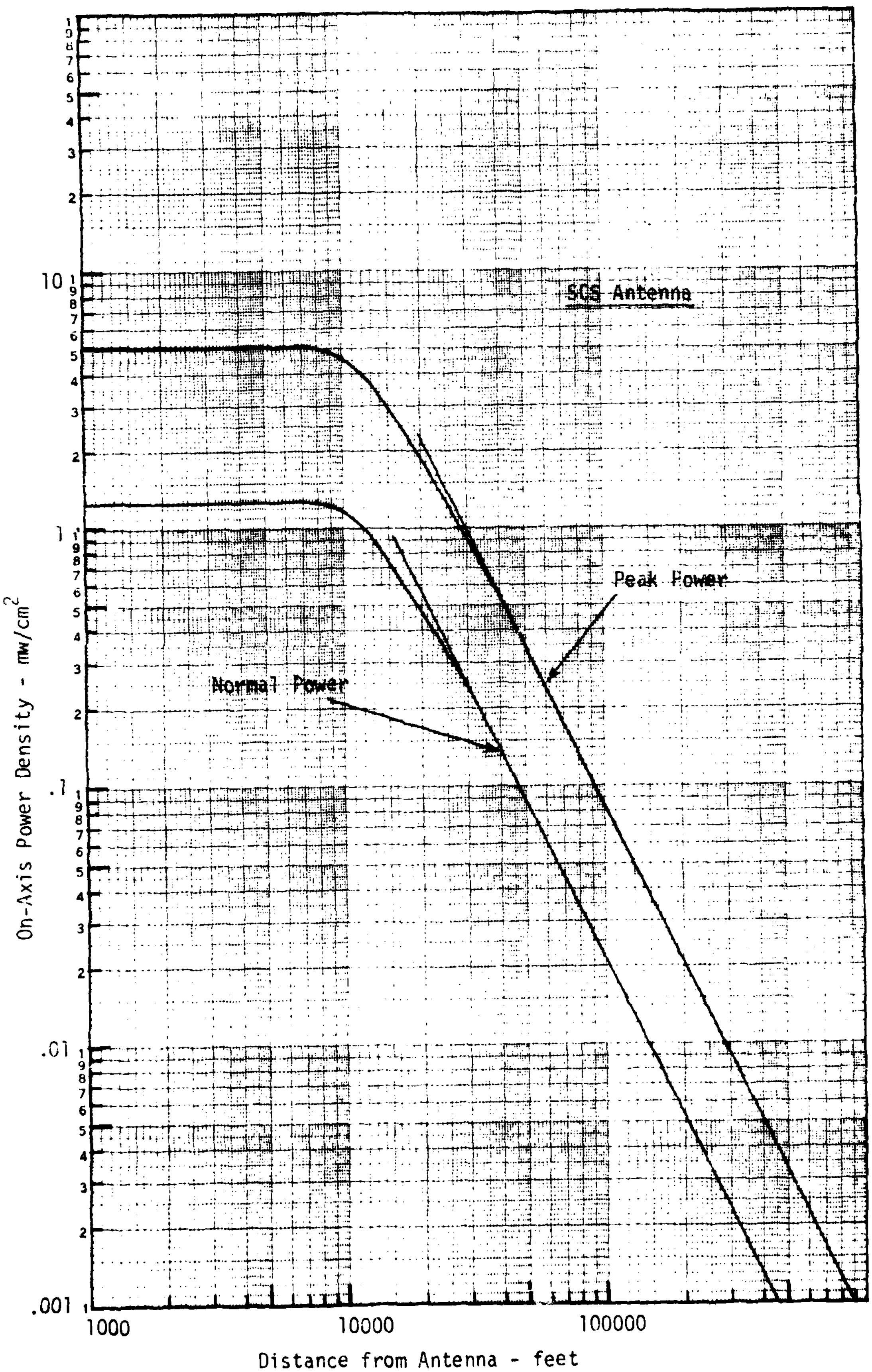
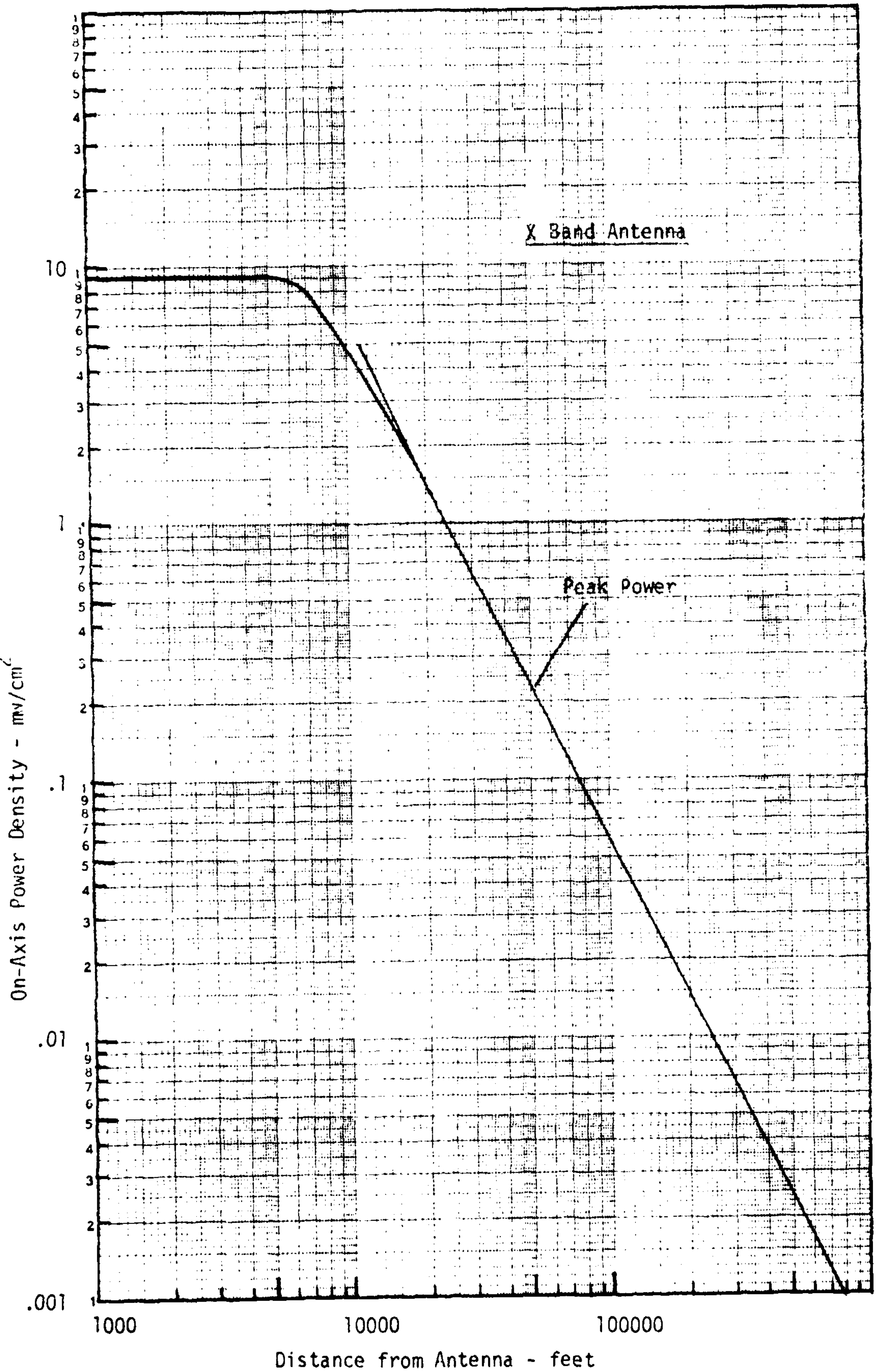
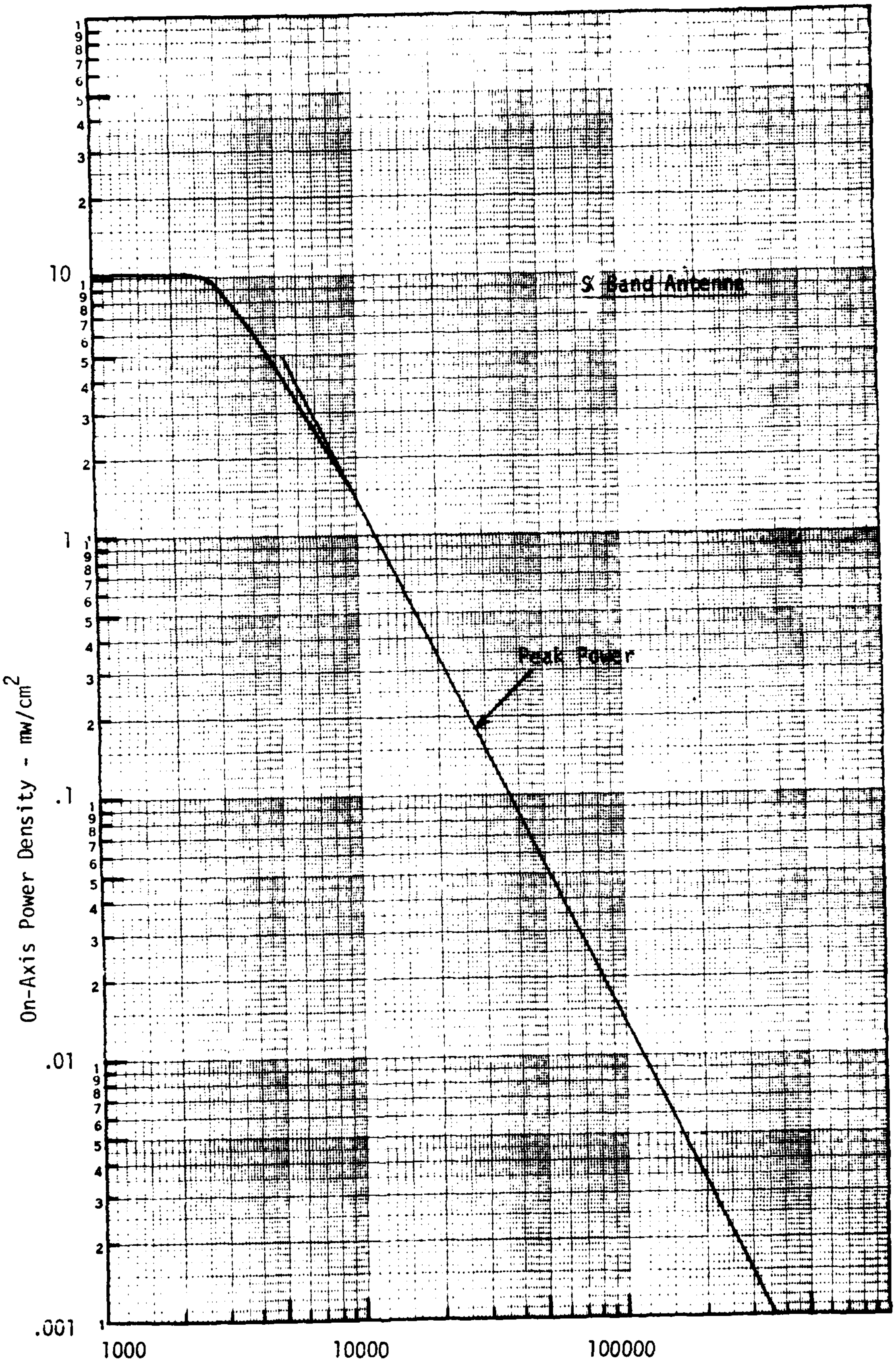

SCS Antenna
Peak Power
Normal Power
On-Axis Power Density - mw/cm^2
10
1
.1
.01
.001
1000
10000
100000
Distance from Antenna - feet

Figure 4



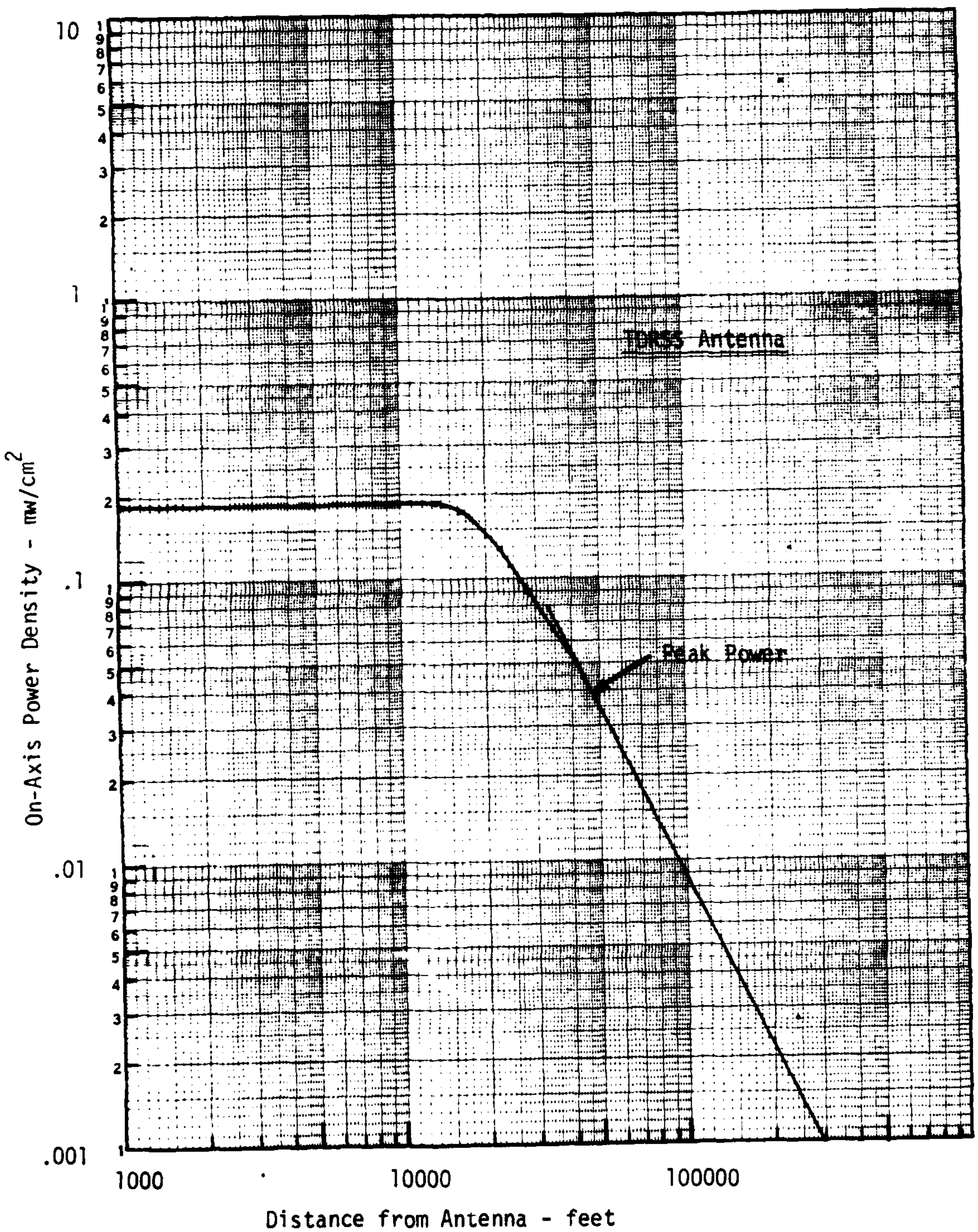
X Band Antenna
Peak Power
10
1
.1
.01
.001
1000
10000
100000
Distance from Antenna - feet
On-Axis Power Density - mw/cm^2

Figure 5



S Band Antenna
Peak Power
On-Axis Power Density - mw/cm2
10
1
.1
.01
.001
1000
10000
100000
Distance from Antenna - feet

Figure 6



TDRSS Antenna
Peak Power
10
1
.1
.01
.001
1000
10000
100000
On-Axis Power Density - mw/cm²
Distance from Antenna - feet

Figure 7

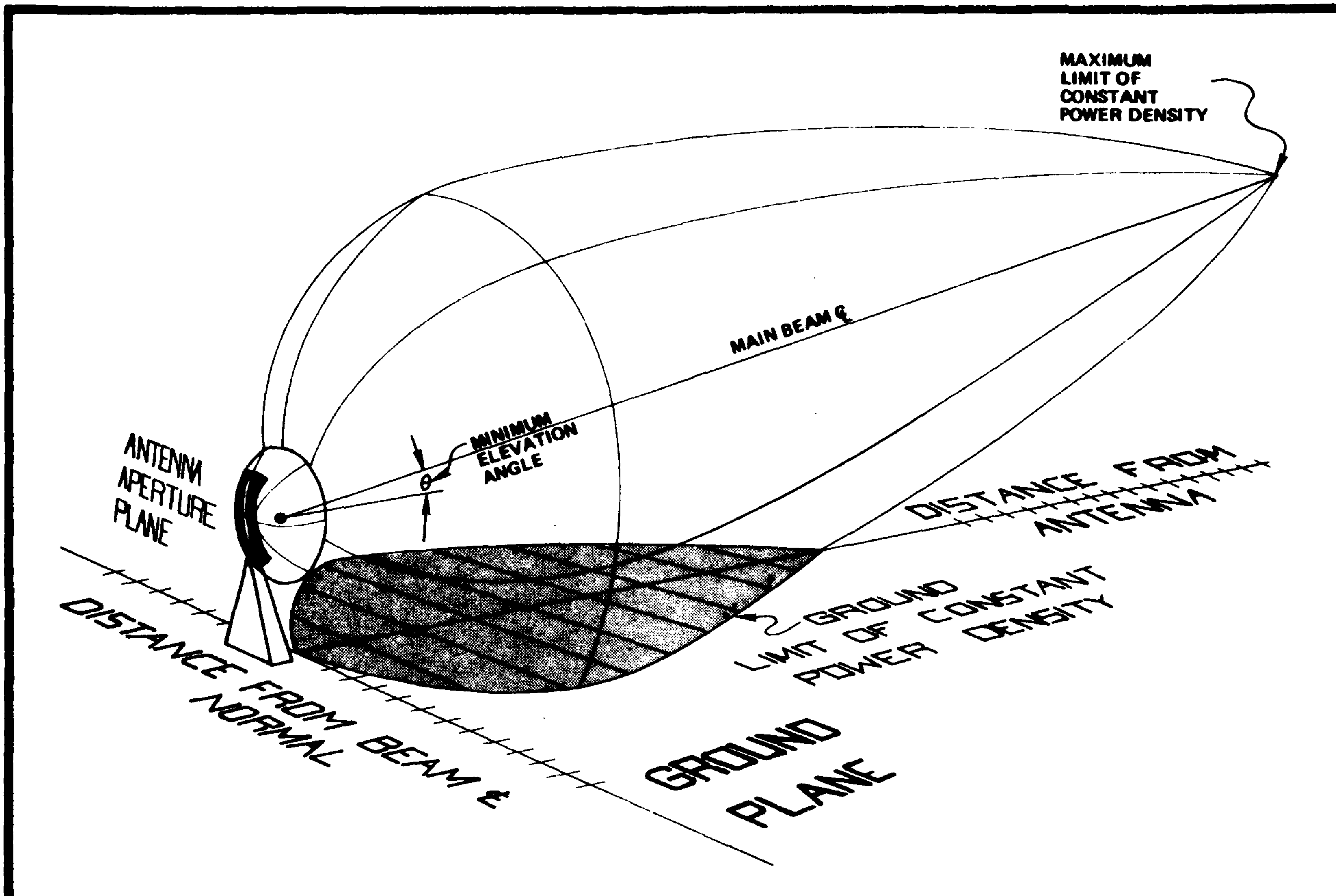
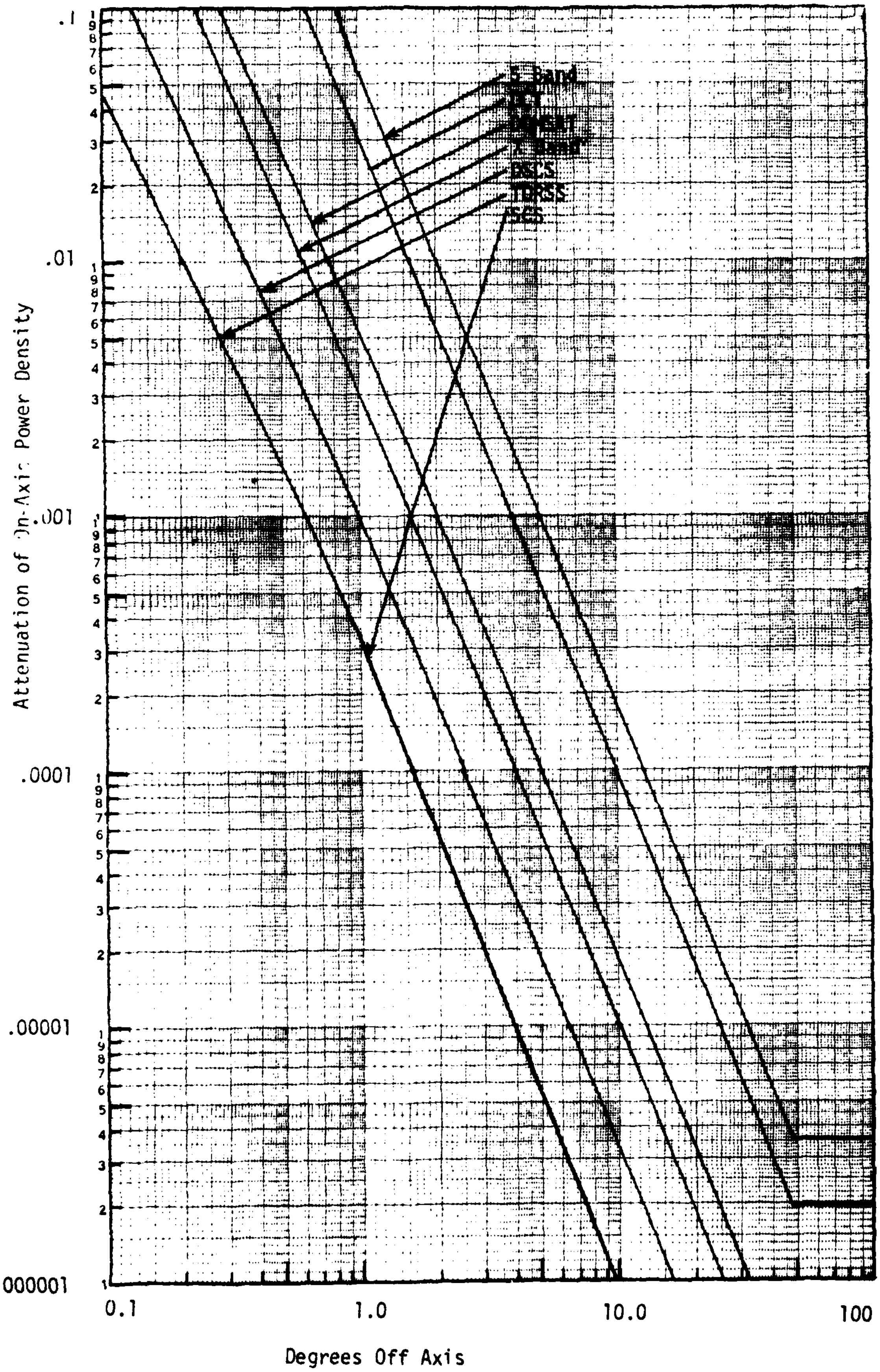


FIGURE 8 Constant Power Density Envelope Illustration



S-Band
DSCS
TDRSS
SGS
.1
.01
.001
.0001
.00001
.000001
0.1
1.0
10.0
100
Attenuation of On-Axis Power Density
Degrees Off Axis

Figure 9

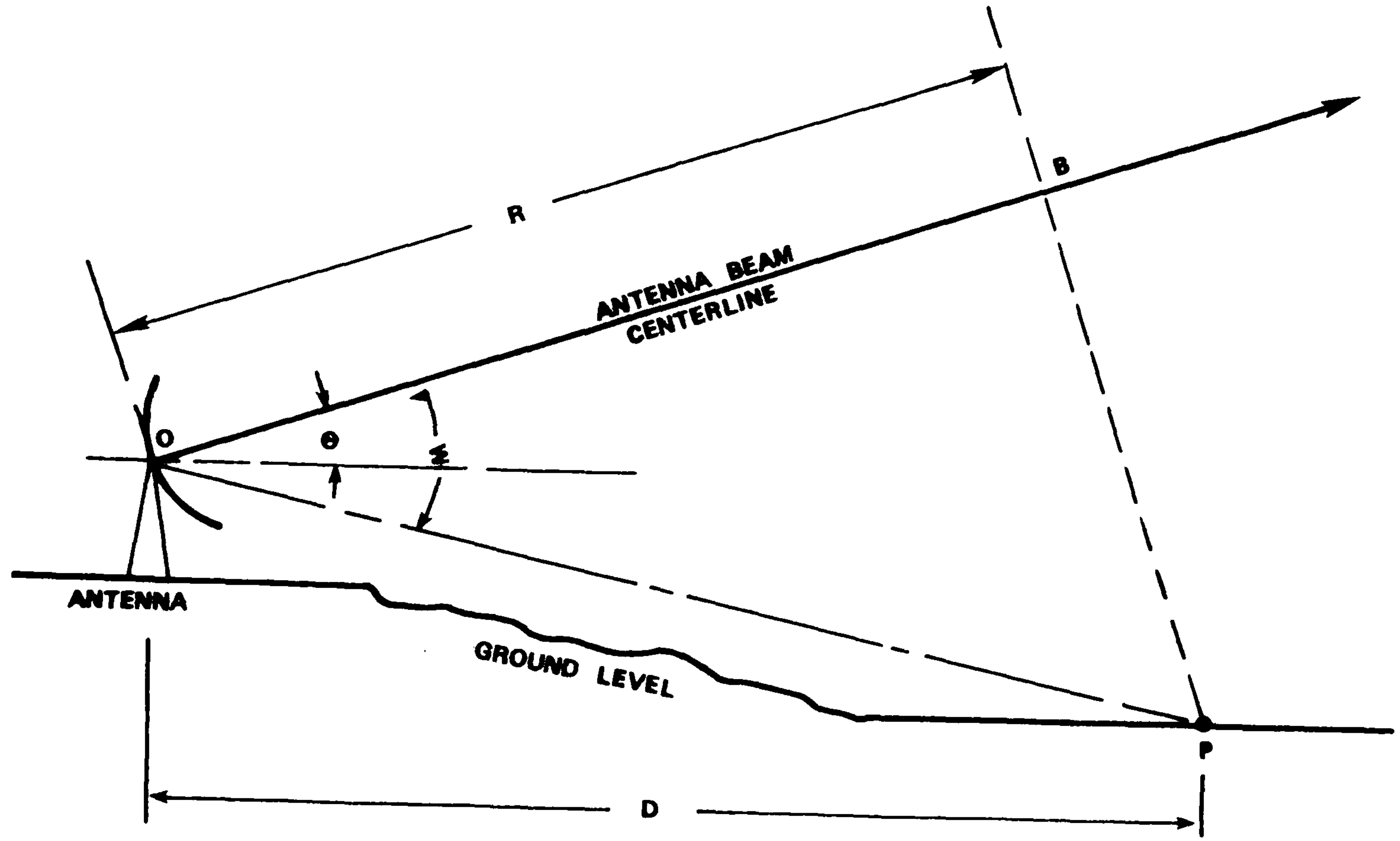


Figure 10 Ground Level Power Density Geometry

APPENDIX B

Intersection Capacity Utilization (ICU) Analysis

A recently developed method of capacity analysis has been used in our studies which directly relates available capacity to key intersection movements and optimizes total intersection capacity, regardless of present signal timing. This method calculates the capacity per hour of green time for each approach according to the Highway Capacity Manual of 1965. It then determines the proportion of total signal time needed in a single hour by each conflicting key traffic movement and compares it to the total time available (100 percent of the hour), arriving at a percentage.

Conflicting key traffic movements are those opposing movements which, when combined, require the highest amount of green time. For example, if a northbound left turn opposed by a southbound through movement require 20 percent of the hour while the southbound left and the northbound through movements take only 15 percent, the northbound left turn and southbound through would be considered the key conflicting movements at the intersection in the north-south direction.

The ICU method for calculating operational time requirements translate to a level of service. ICU represents the proportion of the total hour required to accommodate intersection demand volumes if all approaches are operating at capacity (100 percent = Level of Service E). This does not mean, however, that Level of Service E is appropriate for urban design, but that the evaluation of present and future operating conditions in terms of total capacity is more realistic than looking at a particular approach in terms of present signal timing.

When a level of service is determined for an intersection based on the ICU method, which looks only at the key conflicting movement, it does not necessarily indicate that the other movements through the intersection are also operating at the same service level. Many movements may be operating at a significantly higher level of service.

The levels of service, as defined below and in the 1965 Highway Capacity Manual, are listed in the following table with their corresponding ICU and Load Factor equivalents.

Level of Service*	Load Factor	Equiv. ICU
A	0.0	0.0 - 0.6
B (rural design)	0.1	0.6 - 0.7
C (urban design)	0.3	0.7 - 0.8
D (maximum urban design)	0.7	0.8 - 0.9
E (capacity)	1.0	0.9 - 1.0

*Level of Service definitions from 1965 Highway Capacity Manual.

Service Level A

There are no loaded cycles and few are even close to loaded at this service level. No approach phase is fully utilized by traffic and

no vehicle waits longer than one red indication. Typically, the approach appears quite open, turns are made easily, and nearly all drivers find freedom of operation.

Service Level B

This service level represents stable operation where an occasional approach phase is fully utilized and a substantial number are approaching full use. Many drivers begin to feel restricted within platoons of vehicles.

Service Level C

This level still represents stable operating conditions. Loading is still intermittent but more frequent than at Level B. Occasionally drivers may have to wait through more than one red signal indication, and backups may develop behind turning vehicles. Most drivers feel somewhat restricted, but not objectionably so.

Service Level D

This level encompasses a zone of increasing restriction approaching instability at the intersection. Delays to approaching vehicles may be substantial during short peaks within the peak period, but enough cycles with lower demand occur to permit periodic clearance of developing queues, thus preventing excessive backups.

Service Level E

Capacity occurs at this service level. It represents the most vehicles that any particular intersection approach can accommodate. Full utilization of every signal cycle is seldom attained no matter how great the demand, unless the street is highly friction free.

APPENDIX C

PERMITS REQUIRED FOR CSOC

Requirement	Colorado Springs	Albuquerque	Great Falls
Air Emission Notice	No	No	No
Construction Permit - Air	Yes	Yes*	No
Operating Permit - Air	Yes	No**	No
Incorporation into 208 Plan	Yes	No	No
Construction Permit - Water	Yes	Yes	Yes
NPDES Permit - Water	Yes	Yes	Yes

* At Kirtland AFB, although the furnace size is marginal, if coal is used as fuel for heat a permit will likely be required, but if gas or oil is used as the fuel source no permit will be needed.

** Other Construction Permit for Air suffices

END

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